JULY, 1936

Engineering and Mining Journal

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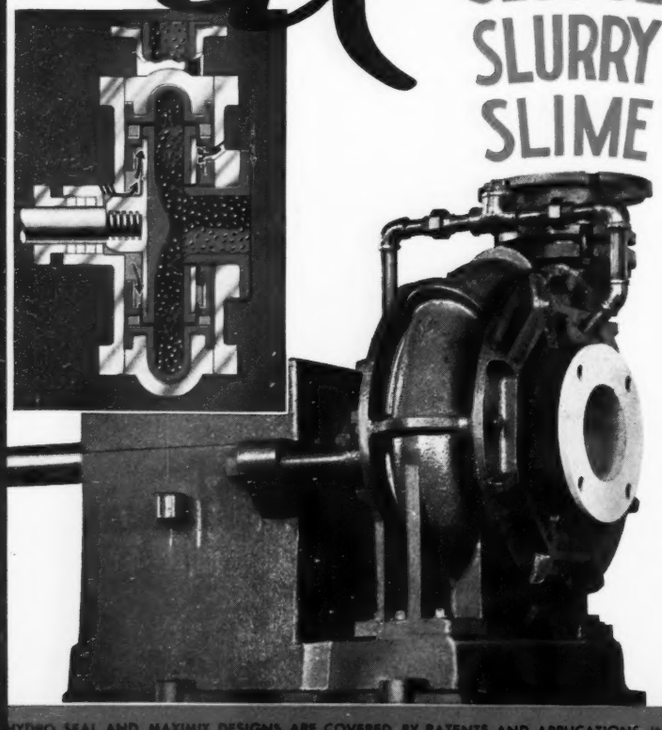
ENGINEERING & MINING WORLD

Cut SAND SLUDGE SLURRY SLIME Pumping Power Costs



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The San Francisco Mines of Mexico, Ltd., in the State of Chihuahua, Mexico, will be the subject of a special issue of *E. & M. J.* next month. The company is expanding mining, metallurgical, and allied operations. Recent development of veins found underneath a basalt-capped mesa and the treatment of complex oxide and sulphide ores sent from three mine units to a central mill, via a unique aerial tramway, are features of interest.

✻

Industrial activity increased for the third consecutive month during May, according to the regular monthly survey of the National Industrial Conference Board. Indexes of trade and distribution reflect a continued advance. Corporation security flotations during the first five months of 1936 were higher than for any comparable period since 1931, with refunding issues comprising 35 per cent of total financing. In the 1929 period they amounted to only 17 per cent.

✻

Centennial. The present patent system of the United States was created by an act of Congress on July 4, 1836. Patent No. 1 under this act was issued July 13, 1836, and started the series, which now numbers over 2,040,000. The first patent law of the Federal Government was passed in 1790, the first patent being issued on July 31 of that year. Some of the colonies issued patents even before that date. The first of these will pass its three hundredth anniversary five years hence.

✻

Blackboards have their uses in the mining industry. One of them, of generous size, covers a wall in the mill office of a large Canadian gold mine, where the superintendent often resorts to it in working out his problems and in conferences.

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FOR JULY, 1936

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The Anglo-Yugoslav Review has just made its first bow, under the date of January-April, 1936. Published at Belgrade by the Society for Promoting Anglo-Saxon Culture in Yugoslavia, one of its purposes, according to Milorad Vanlic and Petar Milivojevic, the editors, is to make Yugoslavia and its culture better known to other peoples. Appropriately, it includes an article on "The Cultural Values of the Good-Neighbor Policy in the Development of Mineral Resources," by our friend Charles Henry White, geologist and member of the Society, and three papers by other writers on mining prospects, oil shales, and radio-active spas respectively.

✻

Production of gold in Australia in the first quarter of the current year registered a substantial increase as compared with the corresponding period of 1935. The output for the 1936 quarter amounted to 244,966 fine ounces, against 153,580 ounces in the first three months of 1935. The value of production in the 1936 quarter was approximately $9,000,000. It is believed in local mining circles that 1936 may be the most successful year for gold mining in Western Australia since 1910, when more than £6,000,000 ($24,000,000) worth of gold was produced.

✻

Moving and Spotting an 80-foot headframe and a mill which was built into the headframe structure, over a new shaft 2,000 feet distant from its original site were accomplished recently by the Gray Wing Extension Mining Company, operating near Folsom City, Sacramento County, Calif. The operation was necessitated by the discovery of a new ore channel. Besides moving the headframe and mill without dismantling, the hoist house was moved without damaging the units. Three days were required to do the work.

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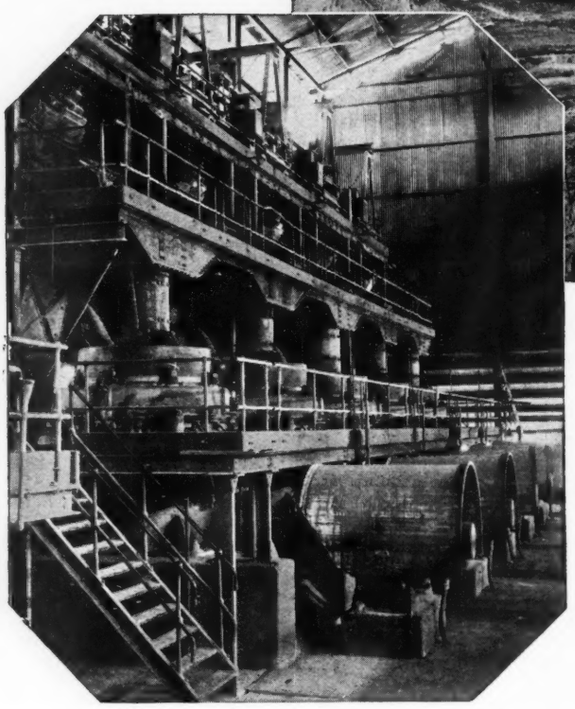
5 SHORT HEAD CRUSHERS *at Roan Antelope*



The above shows the surface operations of Roan Antelope and the interior of the crushing plant where five Short Head 5½-ft. Symons Cone Crushers are installed.

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The Roan Antelope Copper Mines, Ltd., in Northern Rhodesia, Africa, is one of the major copper mining developments of recent years. With the opening up of this property in 1929, six Standard 5½-ft. Symons Cones were chosen to do the reduction crushing. Later when the Short Head Cone was available, five of the 5½-ft. size were installed to follow the Standard crushers to make a still finer product. This is typical of what other progressive mining companies are doing. Short Head Cones when following Standard Cones produce a finer ball mill feed and greatly reduce the overall cost of crushing and milling. The Standard Symons Cone revolutionized reduction crushing. The Short Head is revolutionizing extremely fine crushing operations.

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Accrediting Engineering Schools

ONE POINT OF APPROACH toward better engineering and more competent engineers is to improve the quality and raise the standard of engineering education. The engineering school produces the raw material from which engineers are developed. So the scope and content of the engineering curriculum, the quality of instruction, and the facilities for laboratory work become matters of vital import. They affect not only the future welfare of the student, but also the standing of the engineering profession and the success of the industries that rely on engineering service. Since engineering education has a well-defined objective, it ought to be possible to establish reasonable educational standards that will be acceptable to both the producer and the employer of the engineering graduate.

Other professions, notably the medical and the legal, have been powerful influences in raising the standards of education in their professional schools. Medical and bar associations have winnowed the good schools from the poor. By extending or withholding official recognition, and by publishing lists of accredited or approved institutions, they have caused the schools steadily to improve the quality of their instruction and raise the qualifications of their graduates. In this way these professions have protected themselves and the public from poorly prepared and incompetent practitioners.

But who was to render a comparable service to engineering education? Until recently there was no central engineering body that could undertake such a program. Of the five major professional societies representing civil, electrical, mining, mechanical, and chemical engineering, only the American Institute of Chemical Engineers had a formal program of inspection and accrediting, with respect to chemical engineering curricula only. But with the organization of the Engineers' Council for Professional Development, a conference of engineering societies was created that could act as a competent medium for studying all engineering curricula and accrediting those deemed worthy of the recognition. Composed of representatives of the American Society of Mechanical Engineers, American Society of Civil Engineers, American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Institute of Chemical Engineers, Society for the Promotion of Engineering Education, and National Council of State Boards of Engineering Examiners, ECPD is now qualified through its Committee on Engineering Schools to carry out an accrediting program.

In fact, the work has been under way during the past academic year. When the committee announced that it was prepared to inspect degree-granting engineering schools in the New England and Middle Atlantic States, the voluntary response was extremely gratifying. Practically every engineering school in those areas invited inspection. Visiting committees composed of engineers in industry as well as in education, and competent to pass on the adequacy of the curricula offered for accrediting, have examined the schools in these regions and have made their reports. No announcement of the results is expected before fall.

The signal success attending this initial effort will doubtless be duplicated when the services of the committee are offered next fall to engineering schools in the remaining five regions into which the country has been divided. As yet relatively few curricula in mining engineering have been offered for inspection. But their number will increase as the process is extended among Western institutions of learning.

Behind the accrediting program of ECPD is the purpose of improving the quality of engineering instruction in the United States. But there is considerable merit in the idea of developing a single list of accredited engineering schools throughout the country. Numerous lists of this character have been made by various agencies, such as regional educational bodies, but they are

seriously defective and inconsistent with respect to engineering. Frequently they are only quantitative estimates compiled from catalogs and questionnaires, and they lack the qualitative element that is obtained only by personal visit and inspection of facilities. It is to avoid such inconsistencies and defects, as well as to apply a single set of standards throughout the country, that this nation-wide program has been undertaken by competent representatives of the entire engineering profession.

There is no compulsion in this matter, but in our judgment schools of mines throughout the West should welcome the proffered service of ECPD's Committee on Engineering Schools. Eastern institutions already inspected report substantial benefits obtained from the induced self-examination and from the exchange of views and discussions with members of the visiting committees. If points of weakness are revealed there is a commendable determination to strengthen them. On the whole, a lively spirit of rivalry has been engendered, not only between neighboring institutions, but between engineering departments in the same school. When the accredited list is finally compiled, no engineering school of consequence, nor any of its departments, will want to be among those absent. The accrediting process should have a wholesome effect on engineering education.

The Rand's Jubilee

PRODUCTION OF GOLD on the Witwatersrand began in 1886. In the intervening fifty years the gold mining industry of that small area has developed into a huge enterprise, leading that of all other countries in quantity and value of output. Roundly seven billion dollars is the value of the gold contributed by the Rand to the world's treasure in the past half century.

It is a test of the imagination to realize the tremendous incidence of this activity on the social and economic development of South Africa. In his address as president of the Transvaal Chamber of Mines, Mr. V. A. Mackenzie rightly said that, but for the beneficent influence of gold mining, "the Union today would have been a State of very minor importance and of limited possibilities and opportunities for its citizens." Certainly Johannesburg with her half million people stands as a monument of civic, social, and cultural development, with her industry, commerce, and trade depending heavily on the gold-mining industry.

Nor is the end of future development in sight after fifty years of growth. Fifteen new mines are being opened this year, and thirteen new main vertical shafts are being sunk on old established properties. True, the shadow of excessive taxation still hangs over the industry, but the future is bright enough to be faced with satisfaction, and the Jubilee should be an occasion for justifiable pride and rejoicing.

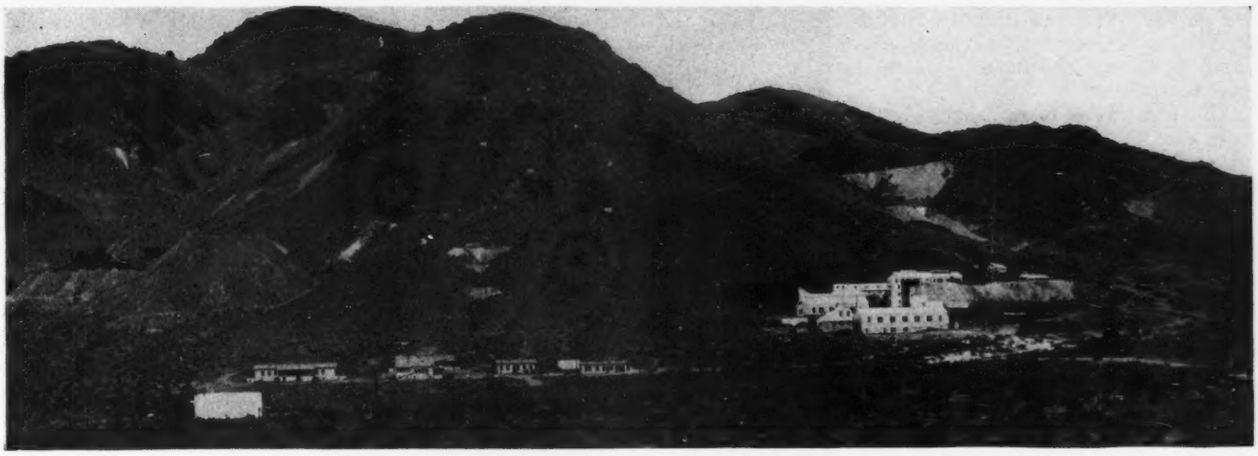
John Hays Hammond

WHEN he published his autobiography on his eightieth birthday, March 31, 1935, John Hays Hammond completed an exacting task such as is rarely undertaken by men at a time when both mind and body are accustomed to seek well-earned leisure. The work was finished none too soon, for fifteen months later his death at Gloucester, Massachusetts, on June 8, 1936, closed a career that was at once successful, colorful, illustrious, inspiring, and worthy of the printed record.

Mr. Hammond gained fame and fortune as a mining engineer, and he would have been a conspicuous figure if he had confined his interests to professional work alone. But he was also an outstanding example of the engineer in public life. From his boyhood he had been thrown into association with presidents, ambassadors, and generals, and in his maturity he could claim personal acquaintance with all the presidents from Grant on, with the sole exception of Arthur. So it is not surprising that after his retirement from professional work he "prospected in politics," being particularly active in the nomination of Taft, and even "flirting with the vice-presidency" himself. But he steadfastly declined public office, either elective or appointive, preferring the private rôle of confidant and adviser.

Nor was his eminence recognized only in his native land. His education and experience were international in scope, and he continually met and associated with distinguished men in business and social life throughout the world. As mining consultant to Cecil Rhodes he influenced the course of the industry in South Africa, and as a participant in the abortive Jameson raid he was a leader in the civil revolt against the Boer policy toward foreigners. He refers to these years as "the most dramatic and critical period of my life," for they culminated in his sentence to death, followed by reprieve and return to London.

One of his last public appearances was as guest of honor at a dinner in New York given by the Boys' Clubs of America, at which he was presented with a medal by Charles M. Schwab. The incident typified his breadth of human interest throughout a long and active professional life.



CYANIDE PLANT (at the right) of the Golden Queen, on the flank of Soledad Mountain

The New Mill of the Golden Queen

A straight countercurrent cyanide plant that is up to the minute in its equipment

Otto Wartenweiler
Engineer
920 Santee St., Los Angeles, Calif.

IN DESCRIBING here in considerable detail the design and construction of the Golden Queen mill my purpose is primarily to present a picture of a modern reduction plant using the cyanide process. I stress the word "modern," because, aside from employing the most modern equipment, the plant embodies no metallurgical features which could be called entirely new or outstanding.

The history of the property now known as the Golden Queen mine is not very old. From the momentous discovery of the rich float near the very top of Soledad Mountain to the acquisition of the property by the Gold Fields American Development Company, a subsidiary of the Consolidated Goldfields of South Africa, only a little more than two years' time was required to reach the stage of normal operation of the completely equipped mine producing 300 tons of gold-silver ore per day, which is treated in an up-to-date reduction plant.

Part of the mine program called for driving a tunnel at the proper location, from the surface to the orebody, to permit hauling the ore to the mill. From the time this tunnel was definitely located, which in turn determined the location of the mill, only 7½ months elapsed until the plant started production. Design and construction were carried out simultaneously.

Thorough laboratory tests revealed no metallurgical difficulties attendant upon treating the ore. They indicated conclusively that all-sliming cyanidation was the treatment to be used. Certain physical conditions gave more concern, especially the hardness of the ore. One test report contains the following paragraphs:

"1,000 grams of ore required 10 minutes' grinding to put 87.8 per cent through 10 mesh. . . . Standard practice on various ores requires 2 minutes on soft ores to 5 minutes on hard ores. . . . Average ores such as Tybo ore requires about 3 minutes, Idaho-Maryland ore 3.5 minutes, and Brunswick ore 5 minutes.

"On fine grinding, a normal ore is ground from 10 mesh to minus 200 in from 8 to 10 minutes in the laboratory tube and pebble mills. The Golden Queen ore required 20 minutes' time to grind from 10 mesh to minus 200 mesh.

"The same deduction on fine grinding is reached as on the coarse grinding. About one-half the normal capacity of the mill.

"As near as comparable laboratory data may be weighed with actual field data, it appears that if an 8 ft. by 48 in. Hardinge mill will grind a normal ore to minus 10 mesh at the rate of 500 tons per 24 hours, it would probably only grind around 250 tons per 24 hours of this ore."

The results of these grinding tests demanded careful consideration in determining the proportions of the crushing and grinding equipment. This in turn reflects directly upon the cost of installation. Applying the usual yardstick for comparing cost of installation per ton of mill capacity, it must be remembered that the crushing and grinding equipment handling 350 tons of Golden Queen ore would have a capacity of about 700 tons of ore of average hardness.

The final design of the mill called for a plant capacity of 300 tons per 24 hours. However, it was considered desirable to be able to treat 350 tons in case custom ore should be purchased. It was further considered possible that the plant might be operated at half capacity for some periods and again, that the capacity later might have to be increased to 500 tons.

The basic idea, however, controlling the economics of the investment, was the anticipation of a comparatively short period of operation. All these points had considerable bearing in proportioning the various mill units and in completing the layout. Extreme stress had to be

laid on low cost of construction and on dependable mechanical handling of material to obtain the lowest operating costs possible.

All work was done on company's account except excavation, welding of steel tanks and water-supply pipe line, erection of steel buildings, and painting.

The soil conditions were favorable for steam-shovel excavation, the material being chiefly cemented sand of various degrees of fineness. Based on preliminary examination, the figure for maximum soil bearing capacity to be used in connection with the design of foundations was fixed at 5,000 lb. per square foot. This value was sustained by subsequent excavation, and in very few instances soft material was struck where the foundations had to be extended lower than had been expected.

At some of the most important and delicate foundations, for instance at the ball-mill floor, soil conditions were found not to be uniform and steps had to be taken accordingly to prevent uneven settling and consequent bearing and gear troubles.

Due to the close proximity to Los Angeles, the labor turnover was rather high and labor efficiency was not the best. Climatical conditions were favorable except during the first construction period, when the ever-present brisk Mojave breeze caused considerable interference and delay.

An ideal mill site was available. Fullest advantage of this site, however, could not be taken, because the upper elevation was governed by the level of the mine tunnel through which the ore is being hauled to the mill, and also for the reason that the area presented was somewhat limited in size.

As stated previously, the metallurgical treatment adopted is the all-slime cyanide process. Continuous countercurrent decantation is used, followed by filtering to provide a final wash and to recover as much solution as possible.

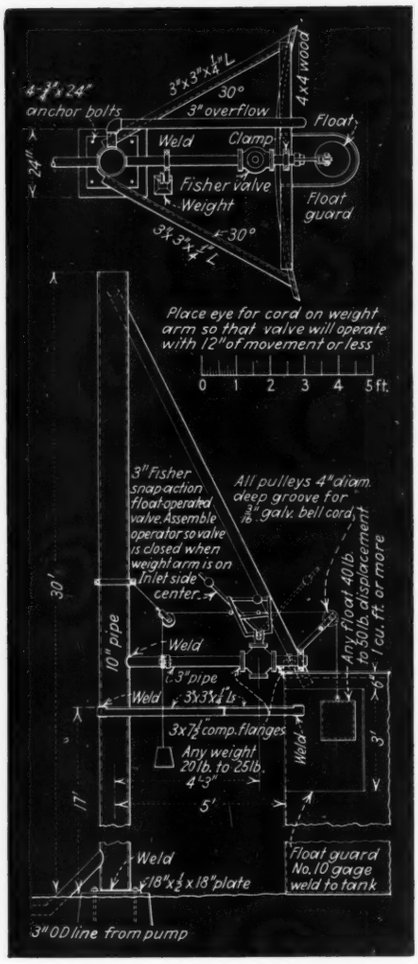
Water Supply—Water is rather scarce in this district. Its use must be limited, and of necessity waste should be reduced as much as possible. The main supply for the Golden Queen is secured from a well about 5 miles away and 300 ft. below the plant reservoir.

The following conditions were set for the operation of the water-supply installation:

1. A supply tank of 60,000-gal. capacity located well above the plant and 400 ft. above the reservoir must always be full, within 12 in. from the top.

2. A reservoir of 200,000-gal. capacity located directly below the plant must always be full within 18 in. from the top.

3. All pumps must be reliably automatically controlled, requiring only acasional attention on the part of an operator or electrician attached to the mill.



STANDPIPE AND CONTROLS

at the 45x18-ft. reservoir tank of the Golden Queen mill. By means of this novel equipment, the booster pump, five miles away at the well, which delivers water to the reservoir from the well supply tank, is automatically controlled

At the well a Wintroath deep-well pump with a capacity of 100 g.p.m. direct-connected to a 7½-h.p. motor is operating under a suction lift of 200 ft., discharging the water into a booster tank 10 ft. in diameter and 14 ft. high. This pump is controlled by an electric float switch actuated by the water level in the booster tank. Two booster pumps, one being a standby, deliver the water from the booster tank to the reservoir. They are Worthington horizontal duplex piston pumps, chain-driven by 25-h.p. motors. These pumps are automatically controlled by the water level in the reservoir 5 miles distant. This control proved to be a little more difficult, for two reasons: first, because an ordinary float-operated switch could not be used, inasmuch as it takes the well booster pump 15 minutes to raise the water level one inch when no water is drawn from the reservoir, and, second, because an electric line to the well would have been too expensive. The difficulty was overcome by a somewhat novel solution. At the reservoir is a specially designed snap float valve which is actuated by the variation of the water level in the reservoir proper. Near the well booster pump is an instrument built by the Electric Controller & Manufacturing Company, of Cleveland, called the automatic altitude regulator. The operation of this instrument is based on the variation of a few feet of static head in the main pipe line produced by a small standpipe built in the line at the top of the reservoir, and it causes the well booster pumps to start and stop electrically. On the dial of this instrument every step of action may clearly be observed:

First, the indication of the total pumping pressure, consisting of static plus friction head. Second, closing of the snap float valve actuated by the rising water level in the reservoir. Third, indication of the predetermined rise of static pressure in the standpipe located above the reservoir pressure head. Fourth, action of the switch disconnecting the pump motor.

The Electric Controller company, after a careful analysis of the conditions and after approval of the proposed hydraulic control, guaranteed the functioning of its apparatus, and the combination worked out to entire satisfaction. In view of the fact that the well booster pumps are of the positive displacement type, and not of centrifugal design, each pump is equipped with an individual pressure-relief valve, which is tested at regular intervals.

At the reservoir, two booster pumps are placed, one again a standby, for the purpose of pumping the water to the supply tank. On account of the desirability of interchangeability, these pumps are identical with those at the well, the motors, however, being 15 h.p., owing to the fact that the operating pressure is less. These pumps are controlled by a float-operated electric switch located at the supply tank, with an electric line to the motors at the reservoir, the distance being relatively short. This simple and inexpensive but effective arrangement successfully answers the requirements set up for the water-supply system.

Power Conditions—The electric power used is furnished by the Southern California Edison Company at 1,100 volts and 50 cycles. The general change over to 60 cycles anticipated in the Los Angeles district when power from the Hoover Dam becomes available is not expected to affect the Mojave district.

Power is purchased under a schedule (PC-1) which provides substantial discount for power-factor improvement. A study was made, therefore, analyzing the load conditions, with the result that enough synchronous motor capacity was provided to make it possible to bring the power factor to unity. The maximum discount equals 10 per cent of the total monthly power bill.

With few exceptions, all electrical equipment was furnished by the Westinghouse Electric & Manufacturing Company. Economy was practiced in installing motors of 100 h.p. and over that are wound for 2,200 volts, whereas the smaller motors are wound for 400 volts. These two features require a rather elaborate and expensive switchboard control.

The Crushing Plant—The mine delivers the ore in 2-ton, 18-in. gage V-bottom cars drawn by storage-battery locomotives having a total weight of 8,500 lb.; a normal rated drawbar pull of 1,000 lb.; and a normal rated speed of 3½ miles per hour. There are two commutating pole motors of 6 h.p. each, battery capacity being 19.39 kw.-hr. A 10-kw. motor-generator set provides the charging current. The storage-battery locomotive was given preference over the trolley type for reasons of safety in the mine and because it offered no obstructions in the limited and crowded space at the tunnel portal.

The ore is received in a three-compartment wooden ore bin 16x60x18 ft. high. Two of the compartments, of 112 tons' live capacity each, have hopper bottoms to permit them to be cleaned easily when custom ore is being received. The third, of 346 tons' live capacity, has a flat bottom, and is to be used for company ore only. A 10-in. stationary horizontal rail grizzly is provided the full length of the bin, upon which oversize may be sledged if required. The run-of-mine ore is of a character that will not produce much of this oversize material. It is estimated that at least 30 per cent of the mine run will be minus 2 in. in size. All conveyors in this plant are equipped with dust-proof, sealed New Departure ball bearings "greased for life."

From the primary bin the ore is drawn through five hoppers having 30-in. square openings. These hoppers have no gates, so the ore rests directly on the belt of five apron feeders, 36 in. wide and 4 ft. 2 in. center to center. Each feeder has a ratchet wheel and arm, and all are driven through a single reciprocating connecting rod, which in turn is driven through a fixed-throw eccentric, connected by chain and sprockets to a U. S. Vari-drive motor unit. The slight impact caused by the ratchet drive, transmitted to the ore column, gives much greater assurance of uninterrupted and uniform feed than a belt of continuous movement. The speed of this unit can be varied in any degree between 296 r.p.m., which is equivalent to 96 to 32 strokes per minute and allows feeder speeds from 12½ to 4 ft. per minute. Individual feeders are cut out simply by disengaging the dog from the ratchet wheel.

These feeders are directly above and parallel to a horizontal 30 in. by 58 ft. belt conveyor running at 100 f.p.m. and driven by a 5-hp. 65-r.p.m. motor reducer connected to the head pulley by sprockets and chain. The head pulley of this conveyor is a 24-in. diameter x 30 in. magnetic pulley energized by a 5 kw., 125 volt, 7½ h.p., 440-volt motor-generator set. In view of the fact that the ore stream will not consist principally of large pieces which might carry tramp steel past the field of the pulley, it was reasonable to expect that all the iron would be removed, thus protecting both the crushing units.

The 30-in. conveyor delivers to a grizzly which I have called the Copper Queen type, inasmuch as it was developed at that plant. The grizzly has stationary manganese-steel bars, spaced 2 in. apart, which are curved something like a distorted letter *S*. Below the bars is a shaft that carries a series of double manganese-steel arms, set alternately at 90 deg. to each other. Shaft and arms are driven by chain and sprocket from the head pulley shaft of the 30-in. conveyor at 6 r.p.m. As the arms revolve, their tips rise between the grizzly bars and serve the double purpose of turning over the material to allow the fines to drop free and at the same time to push the oversize ahead into the crusher opening. The advantages of this type of grizzly are large capacity, high screening efficiency, and freedom from clogging. It also has the further advantage of requiring less headroom and horizontal space for installation than most of the usual types of stationary and mechanical grizzlies. Oversize, which is nominally plus 2 in., passes to the primary crusher. Undersize drops through a chute to join the discharge from the crusher.

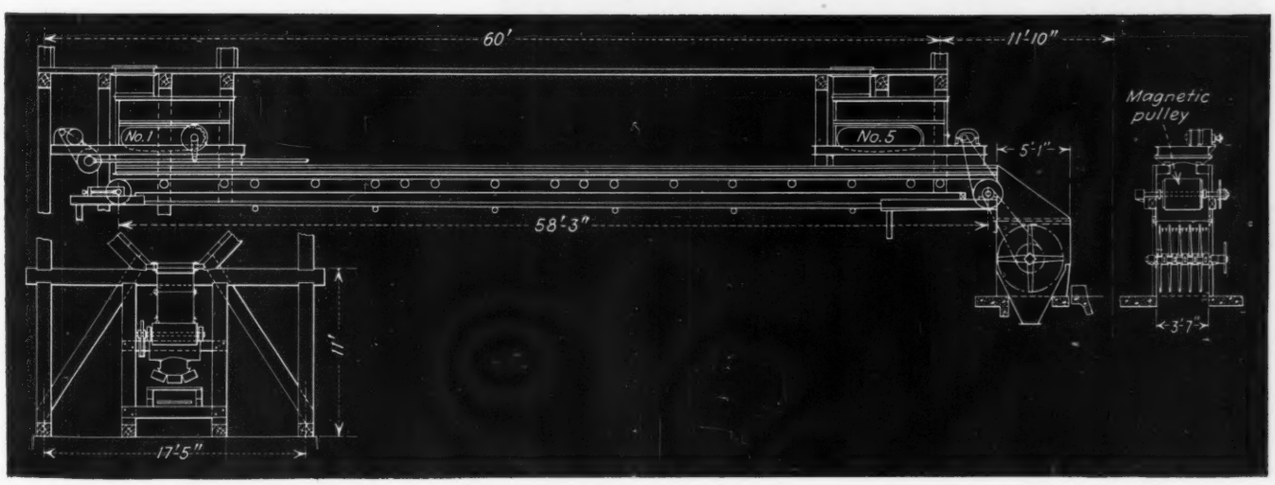
The primary crusher is a 36-in. Traylor TZ bell-type gyratory, equipped with a special bowl and head which permits taking pieces as large as 12 in. This crusher can be set to a minimum of 1¼ in. on the open side and is expected to produce a product 100 per cent 1½ in. in size, at the rate of 70 tons per hour. The machine is driven through a Tex-Rope drive by a 100-h.p., 1,000-r.p.m., 2,200-volt motor.

The crusher discharge, together with the undersize from the grizzly, is delivered by a 24-in. by 118-ft. belt conveyor, inclined at 16 deg., and running at 185 ft. per minute. The conveyor is driven directly by a 5 h.p., 30 r.p.m. motor reducer. It delivers to a 4x5-ft. Hum-mer screen having a ½x⅞-in. mesh screen surface. Oversize goes to the secondary crusher and undersize joins the discharge from the crusher. A small motor-generator set is provided to operate this screen.

The secondary crusher is a 36-in. Traylor Type TZ gyratory unit, with standard head and bowl, permitting a maximum size feed of 7 in. This can be set to a minimum of ¾ in. on the open side (equals ⅝ in. on the closed side). The parts for both primary and secondary crushers are largely interchangeable. Arrangements are such that either crusher may be operated on run-of-mine

FIVE APRON FEEDERS

36 in. wide and placed 4 ft. 2 in. center-to-center, draw the ore from the primary coarse ore bin in the crushing plant and deliver it to a conveyor belt that feeds the primary crusher, following a grizzly. All are driven by a single reciprocating connecting rod through a ratchet wheel and arm



ore independently of the other. By installing two additional short conveyors and another screen, the secondary crusher can be operated in closed circuit to provide a product 100 per cent minus ½ in. As set up at present and operated in open circuit, it is expected to produce 95 per cent minus ¾ in., 75 per cent minus ½ in., and 47 per cent minus ¼ in. material. In this connection it is estimated that if this crusher were operated in closed circuit with its minimum setting, the capacity of the grinding equipment would be increased approximately 20 per cent. Like the primary crusher, it is driven through a Tex-Rope drive by a 100-h.p., 1,000-r.p.m., 2,200-volt motor. Both primary and secondary crushers have 8-ton crawls overhead.

Much thought was given to the selection of the secondary crusher, in view of the hardness of the ore and the fineness of the ball-mill feed desired. In fairness to the manufacturers, who made full-size tests on our own ore, on the strength of which they were willing to guarantee the performance, I must say that all expectations were fulfilled.

The discharge from the secondary crusher, together with the undersize from the Hum-mer screen, is delivered on to an 18 in. by 80 ft. belt conveyor, inclined at 21 deg., and running 194 f.p.m. A Merrick Weightometer is installed near the tail end of this conveyor. The conveyor is driven directly by a 5-h.p., 37-r.p.m. motor reducer.

No. 8 conveyor delivers (on the top floor of the sampling plant) to an 18 in. by 85 ft. horizontal belt conveyor running 215 f.p.m. over the top of the fine-ore bins. It is equipped with a stationary tripper having a three-way spout over No. 1 bin and an end discharge over No. 2 bin. It is driven directly by a 3-h.p., 41-r.p.m. motor reducer. This conveyor runs in a trussed gallery between the sampling plant and the fine-ore bins, leaving clearance below for the construction of two additional ore bins without interfering with operations.

The Sampling Plant—The tower supporting the junction of the conveyor from the secondary crushing plant, and the one to the fine-ore bins, is utilized for the sampling plant. The sampling plant has to answer two purposes: First it has to cut a 3⅓ per cent sample when running Golden Queen ore, and second, it has to cut a 10 per cent sample when running custom ore.

The first sample is cut at the transfer point between the two conveyors by a No. 3 Allis-Chalmers Vezin sampler. This sampler is equipped with three cutters, two being removable, which together have an angular opening of 36 deg., making a 10 per cent cut. By removing two of the cutters a 3⅓ per cent cut can be obtained. Thus on a nominal 300-ton run, the initial sample would be either 60,000 lb. or 20,000 lb., as desired. This sampler is driven by flat belt from a small lineshaft which also drives the 6x4-in. bucket elevator handling the return rejects from the sampling operations. Reject from this first sample falls directly on the conveyor to the fine-ore bins. The sampler is driven at 27 r.p.m. and the elevator at 200 f.p.m., and the lineshaft is operated directly by a 3-h.p. 193-r.p.m. motor reducer.

The sample from the first cut drops directly into a three-ton steel hopper with a 60-deg. bottom, from which it is fed to a second sampler by a 9 in. by 1 ft. 4 in. belt feeder. This feeder is driven at the appropriate speed by a ¼-h.p. 1,500-r.p.m. motor, worm-gear reducer, and chain and sprockets. The chain and sprockets are so designed that the speed can be made one-third of the maximum by removing the chain from one pair of sprockets and placing it upon another, this to accommodate either the 10 per cent or the 3⅓ per cent sample cut. The second sample is cut by a No. 1 Allis-Chalmers Vezin sampler having a single cutter with an angular opening of 36 deg., making a 10 per cent cut. On a 300-ton run this sample will be either 6,000 or 2,000 lb. according to the setting of the first sampler. The sample falls direct to a ¾-ton steel hopper having 60 deg. bottom. The reject is carried by a chute to the boot of the reject elevator.

From the ¾-ton hopper the sample is drawn by a belt feeder similar, except for speed, to the one already described. The third sample is cut by a No. 1 Allis-Chalmers Vezin sampler similar to that used on No. 2 cut. Each of these samplers is driven at 22 r.p.m. by a flat belt from a ½-h.p. 193-r.p.m. motor reducer.

From the third sampler the reject goes to the elevator boot. The sample falls to a 200-lb. capacity hopper, from which it is hand-fed to a 2x6-in. laboratory jaw crusher set to ⅛ in. and driven within a flat belt by a 1-h.p. 1,500-r.p.m. motor. After crushing, it is rolled and hand-riffled with a Jones riffle. The final sample of about 50 lb. goes to the mine assay office and the reject is dumped into the elevator boot.

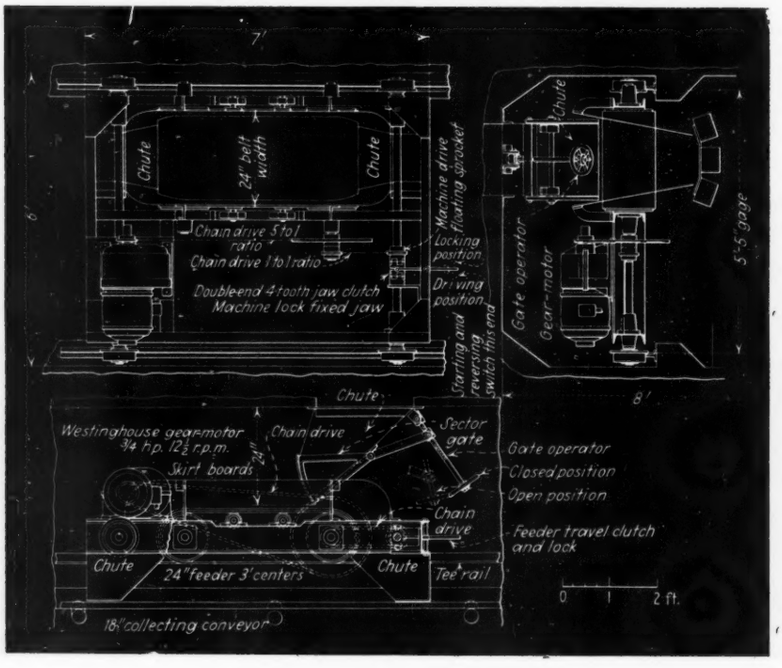
The purpose in providing for either a 10 per cent or 3⅓ per cent initial cut is to allow for the larger sample when running custom ore, which may be in lots of from 50 to 100 tons and which requires maximum accuracy. On company ore only one sample per day is expected, and as the purpose of the sample is for mill regulation, extreme accuracy is not required.

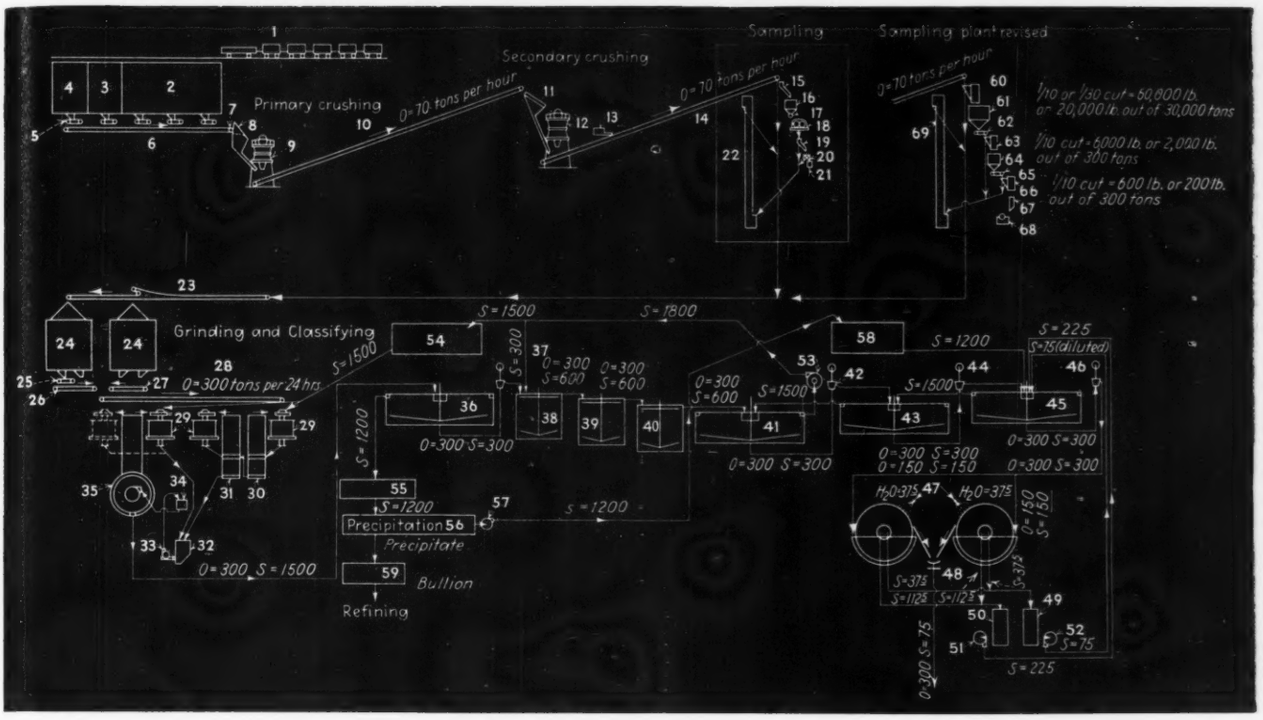
To meet interruptions due to operating troubles, an interlocking control of electric starters has been worked out. From a strategic point in the sampling mill, feeders and conveyors can be stopped and re-started in a manner which prevents spilling or piling up of ore at any place along the line.

Grinding and Classification.—The fine-ore bins consist of two cylindrical steel shells 20 in. diameter by 22 ft. high, without bottoms. They support the conveyor and gallery from the sampling plant on their tops. The bottom of the shells rests on octagonal concrete walls and a concrete tunnel runs approximately along the center of the two shells to provide for reclaiming conveyors. This design permits the major part of the ore load to rest directly on the

A TRAVELING BELT FEEDER

that is reversible and is operated through a motor reducer and a chain drive, is provided in the tunnel beneath the fine-ore bins. It can be positioned beneath any one of four openings in the bin. It delivers to two conveyors in the tunnel





FLOWSHEET OF THE GOLDEN QUEEN ALL-SLIMING CYANIDE PLANT

Continuous countercurrent decantation is used, followed by filtration to provide a final wash and recover as much solution as possible

LEGEND

1. Electric haulage from mine
2. Mine-ore bin, 346 T. live cap.
3. Custom-ore bin, 112 T. live cap.
4. Custom-ore bin, 112 T. live cap.
5. 5 36"x4' 2" apron feeders
6. 30"x58' belt conveyor
7. Magnetic head pulley
8. Copper Queen type grizzly 2"
9. 12"x36" Traylor TZ gyratory crusher
10. 24"x118' belt conveyor, 16° slope
11. 4'x5' Hum-mer screen, ½" mesh
12. 7"x36" Traylor TZ gyratory crusher
13. Weightometer
14. 18"x79' belt conveyor, 18° slope
15. Geary-Jennings automatic sampler, 1/125 cut
16. 1-ton hopper
17. 18"x12" drum feeder
18. 18"x10" Traylor crushing rolls
19. Geary-Jennings automatic sampler, 1/50 cut
20. Jones riffle splitter, ½ cut
21. Sample box
22. 6"x4" bucket elevator
23. 18"x90' belt conveyor
24. 2 250 T. live cap. steel ore bins
25. 24"x3' traveling feeder
26. 18"x18' belt conveyor
27. 18"x14' belt conveyor
28. 18"x15' belt conveyor 20° slope
29. 3 No. 67 Marcy ball mills
30. 6'x21'-8" Dorr classifier, 3½" slope
31. 6'x21'-8" Dorr classifier, 3" slope
32. Pump sump
33. 4" sand pump
34. Surge box
35. 8'x30'x12' Dorr bowl classifier, 2" slope
36. 55'x12' Dorr thickener No. 1
37. 4" Dorrco triplex diaphragm pump
38. 34'x24' Dorr agitator No. 1
39. 34'x24' Dorr agitator No. 2
40. 34'x24' Dorr Agitator No. 3
41. 55'x12' Dorr thickener No. 2
42. 4" Dorrco triplex diaphragm pump
43. 55'x12' Dorr thickener No. 3
44. 4" Dorrco triplex diaphragm pump
45. 55'x12' Dorr thickener No. 4
46. 4" Dorrco triplex diaphragm pump
47. 2 14'x16' Oliver drum filters
48. 18" tailings conveyor, 10° slope
49. Receiver weak solution
50. Receiver strong solution
51. Wesco pump, 225 G.P.M.
52. Wesco pump, 75 G.P.M.
53. Solution pump, 300 G.P.M.
54. 30'x20' mill solution tank
55. 40'x12' pregnant-solution tank
56. Merrill-Crowe precipitation system
57. Solution pump, 200 G.P.M.
58. 30'x20' barren solution tank
59. Refinery
60. No. 3 Vezin sampler
61. 3-ton hopper
62. Belt feeder
63. No. 1 Vezin sampler
64. 1½-ton hopper
65. Belt feeder
66. No. 1 Vezin sampler
67. 200-lb. hopper
68. 2"x6" jaw crusher
69. 6"x4" bucket elevator, 45' centers

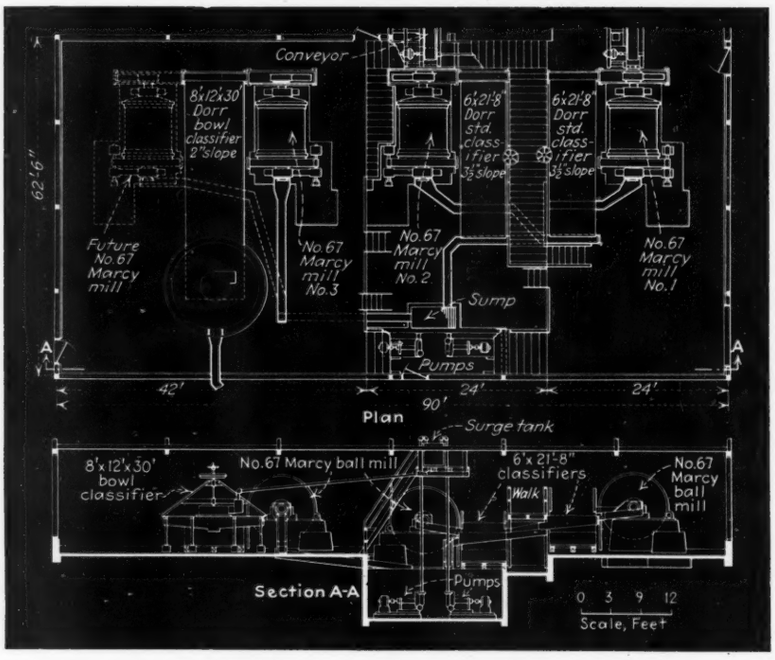
ground, which facilitates very rugged and economical construction. The live capacity of each bin is 250 tons, making a total fine-ore storage of 500 tons. The total live mill storage is therefore 1,068 tons and the total storage equals 1,425 tons.

There are four 2-ft. square openings, two to each bin in the concrete roof of the tunnel under the bins. Each opening is furnished with a steel discharge hopper with a screw-operated sector gate. Beneath the discharge hoppers and supported by rails on the side walls of the tunnel runs a 24x36-in. traveling belt feeder. This feeder may be spotted under any opening. It is driven by a ¾-h.p., 12½ r.p.m. motor reducer, with a chain drive to both feeder pulley and wheel shaft. It is so designed that by moving a lever, operating a double end jaw clutch, the feeder is either locked in position with the belt running, or is unlocked and the power connected to the wheels to move the feeder from one position to another. The feeder travels, and the feeder belt operates in either direction, under its own power.

Below the feeder, and running along the line of the tunnel are two conveyors; one 18 in. by 18 ft. and one 18 in. by 14 ft. horizontal. These deliver to a point nearly midway between the two bins, where they discharge upon an 18 in. by 16-ft. belt conveyor, inclined at 20 deg., which delivers to the combination scoop feeder on ball mill No. 1. Each of the first two of these conveyors is driven by a ¾-h.p., 65-r.p.m. motor reducer through roller chain and sprockets. The inclined conveyor is driven direct by a ¾-h.p., 20-r.p.m. motor reducer.

For emergency operation, in case ball mill No. 1 is down, an opening has been provided in one side of the shell of the easterly ore bin near the bottom. A gate and hopper is installed here, with adjustable reciprocating sector feeder operated by a 1-h.p., 30-r.p.m. motor reducer directly. This feeder delivers to an 18 in. by 16 ft. horizontal belt conveyor, which delivers in turn to the combination scoop feeder on ball mill No. 2. This conveyor is driven direct by a ¾-h.p., 20-r.p.m. motor reducer.

The grinding and classifying plant proper is housed in a wooden frame building, designed according to the requirements of the State of California as to earthquakes, having corrugated iron



THE GRINDING AND CLASSIFYING SECTION

of the Golden Queen mill at the present time comprises three No. 67 Marcy ball mills with two 6 ft.x21 ft. 8 in. standard Dorr classifiers and one 8x12x30-ft. Dorr bowl classifier. Provision has been made for additional future capacity

roof and sides, with concrete floors and footings. This building is 94 by 46 ft. and is arranged for three initial mills, with room for a possible fourth unit. Here the main mill-control switchboard is installed, at the east end of the building. The floor is laid out so that at No. 1 and No. 3 mills it is at the same elevation, with a depression of 2 ft. 6 in. at mill No. 2.

The grinding problem was considered from every possible angle, the result of the investigation calling for extreme flexibility to meet the rather unusual demands in regard to variation in operating conditions, mentioned previously, and also possible physical changes of the ore. A Marcy mill, size 67, was selected. The arrangement finally adopted will permit of the following combinations:

When operating in parallel, mill No. 1 will be in closed circuit with the overflow from classifier No. 1 going to the bowl of No. 3 classifier or directly to thickener No. 1. Mill No. 2 will be in closed circuit with classifier No. 2, the overflow being the same as just mentioned in the foregoing.

When operating in series mills Nos. 1 and 2 can be operated in series with classifier No. 1 going to classifier No. 2. If mill No. 2 should be crowded, the overflow from No. 1 classifier can be split between mill No. 1 and No. 3.

If with three mills No. 1 is down, Nos. 2 and 3 would be operated in parallel. With No. 3 down, Nos. 1 and 2 would be in series.

Thus it will be seen that either stage or series operation can be practiced. This extreme flexibility naturally requires speed control in the operation of the classifiers.

Operating conditions at the ball mill flow with reference to the pulp density, fineness of grind, dilution at classifiers, their respective speeds and overloads will be entirely a matter of experimentation and cannot, therefore, possibly be forecast.

Initial ball charges are as follows:

Mill No. 1, 2,000 lb. 2 in.; 3,000 lb. 2½ in.; 2,000 lb. 3 in.; 3,000 lb. 3½ in.; 5,000 lb. 4 in.; 3,000 lb. 5 in. Total, 18,000 lb.

Mill No. 2, 8,000 lb. 2 in.; 8,000 lb. 3 in. Total 16,000 lb.

Mill No. 3, 8,000 lb. 1½ in.; 8,000 lb. 2 in. Total 16,000 lb.

Ball mill No. 1 is set in a circuit closed by gravity, with a 6 ft. by 22 ft. 8 in. Type DSF Dorr classifier set on a slope of 3½-in. per foot and operated by a 7½-hp. 750-r.p.m. motor.

The overflow from classifier No. 1 is laundered to the feed box of classifier No. 2. This is a 6 ft. by 22 ft. 8 in. Type DSF Dorr classifier set on a slope of 3 in. per foot and operated by a 7½-h.p., 750-r.p.m. motor. No. 2 classifier is in closed circuit, by gravity, with No. 2 ball mill. Its overflow is laundered to a sump at the north side of the building.

A Dorr Turret Type DSFB classifier with an 8x30x12-ft. bowl is set alongside ball mill No. 3 at a slope of 2 in. per foot, so that the sand discharge of the machine goes to the ball-mill scoop box by gravity. Discharge from ball mill No. 3 is laundered to the sump before mentioned. Classifier rakes are operated by a 10-h.p., 750-r.p.m. motor and the bowl rakes by a 2-h.p., 750-r.p.m. motor.

Two 4-in. Hydroseal sand pumps are connected to the sump before mentioned. Each is driven by a 7½-h.p., 1,500-r.p.m. motor, mounted directly above the main pump bearing and driving through a Tex-Rope drive. One of these pumps is a spare. This is considered necessary as the whole grinding operation is dependent upon the continued operation of this pump.

The pumps are equipped with removable rubber liners for the housing and rubber impellers. Stuffing boxes on the pump shaft are kept clear of grit by the introduction of sealing water. In this case, to avoid undue dilution in the circuit, standard mill solution is used for sealing instead of fresh water. These pumps require from 2½ to 5 per cent of the pump output as sealing water, which should be delivered at the pump under a head of from 5 to 10 lb. in excess of the total head on the pump.

In the present operation of the plant the mill solution is supplied under proper pressure by a small centrifugal pump driven directly by a ½-hp., 1,500-r.p.m. motor. Each Hydroseal pump has been supplied with its own booster pump.

The Hydroseal pumps will handle the overflow from No. 1 and No. 2 classifiers plus the discharge from No. 3 mill. The former will amount to 350 dry tons and the latter 625 dry tons (includes circulating load on mill No. 3, estimated at 5:1 on an original feed of 125 tons oversize from the bowl), making a total of 975 dry tons per 24 hours.

The dilution of the combined flows is 2½:1 (40 per cent solids), which, amounts to 300 g.p.m. of pulp having a specific gravity of 1.35. The pump unit installed is expected to be sufficiently flexible to handle from 200 g.p.m. to 400 g.p.m. of this pulp with satisfactory efficiencies.

With the three ball-mill units operating in series and receiving a feed sized to 95 per cent —¾ in., 75 per cent —½ in., and 47 per cent —¼ in., the overflow of the bowl classifier is expected to be 350 dry tons per 24 hours of 100 per cent —150-mesh material.

Launder slopes in the grinding department are shown in the table that follows:

Detail of Launder Slopes

	Inches per Foot
Sand discharge classifier No. 1.	5¼
Discharge ball mill No. 1.....	1½
Overflow classifier No. 1	1¼
Sand discharge classifier No. 2.	4
Discharge ball mill No. 2	1¼
Overflow classifier No. 2.....	1
Sand discharge classifier No. 3.	4
Discharge ball mill No. 3.....	1
Overflow classifier No. 3.....	¾

Provision has been made for the installation of a fourth No. 67 Marcy ball mill, which would also operate in closed circuit with the present bowl classifier. The installation of this machine, plus additional tankage and closed-circuit crushing at the secondary plant, would provide for a milling capacity of 500 tons per day.

Lixiviation—All tankage for thickening, agitating, and solution storage is in the open. All tanks are of steel, painted with a combination P & B aluminum paint outside and with straight P & B paint inside to below the solution line.

The overflow from the bowl classifier is laundered in a 6-in. pipe to the feed well of a 55 ft. diameter by 12 ft. Dorr Type S. Center Pier thickener, driven by a 3-h.p., 182½-r.p.m. motor reducer. The area of this thickener is 2,380 sq.ft., which equals 6.8 sq.ft. per ton per 24 hours settling area, on a basis of 350 tons dry ore per 24 hours feed.

With regards to the overflow, it was considered possible that the frequent winds blowing over the considerable area exposed might disturb the surface to a point of forming small waves and further produce a higher water level at the windward side. In case foaming should take place, the foam would naturally collect at this side, and piling up at the overflow launder rim would interfere with the overflow action.

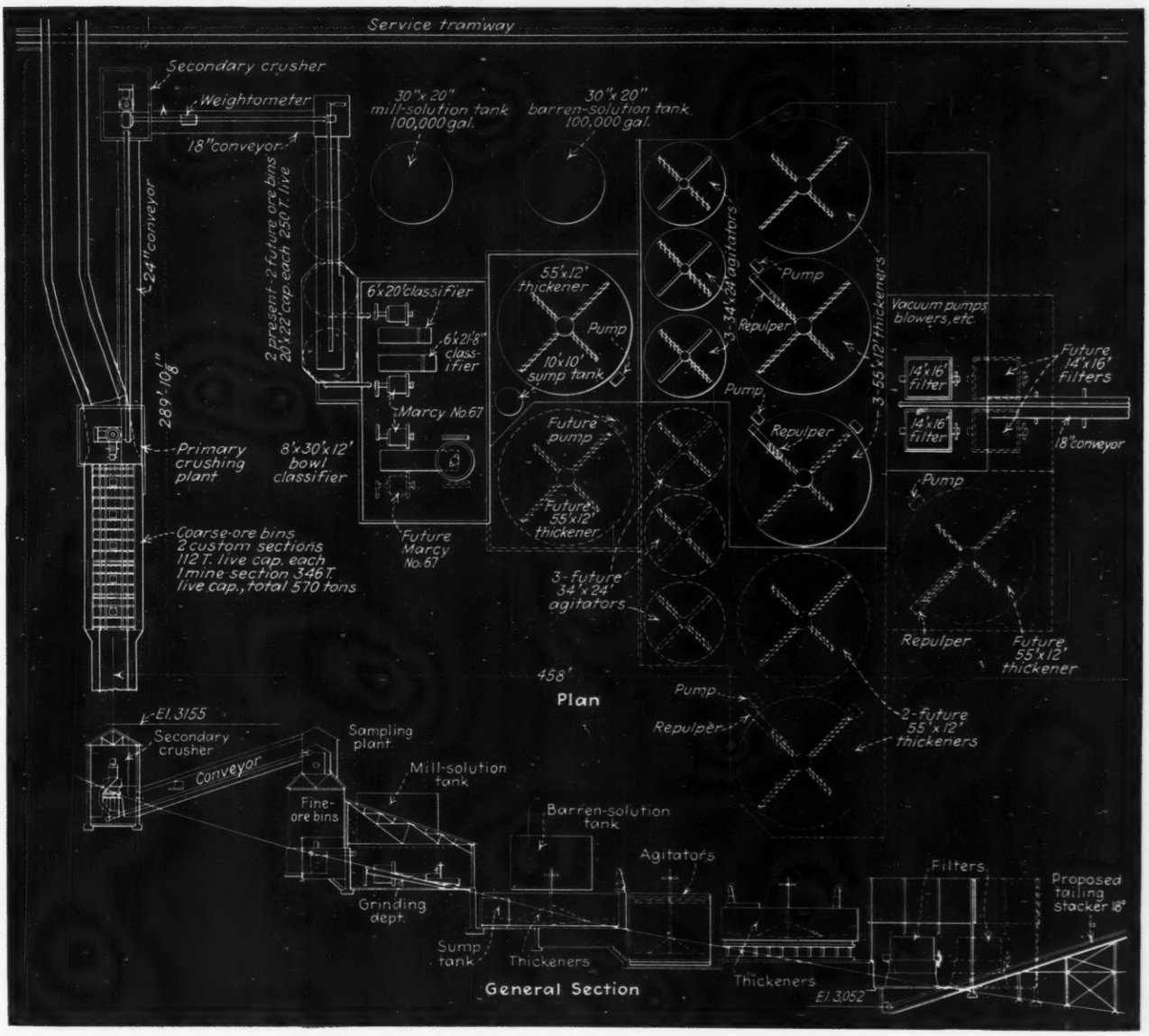
To meet these anticipated conditions a novel overflow launder was designed which was approved by the Dorr Company. Instead of the conventional circular launder attached to the inside of the tank, an octagonal shape was adopted, entirely free and detached from the side of the tank, suspended from brackets fastened to the top angle of the tank. This arrangement introduces three distinct new features. It is easily adjusted vertically and offers twice the overflow surface, and with obstructions present at the inside, normal overflow in quiet water will take place at the tank side of the launder.

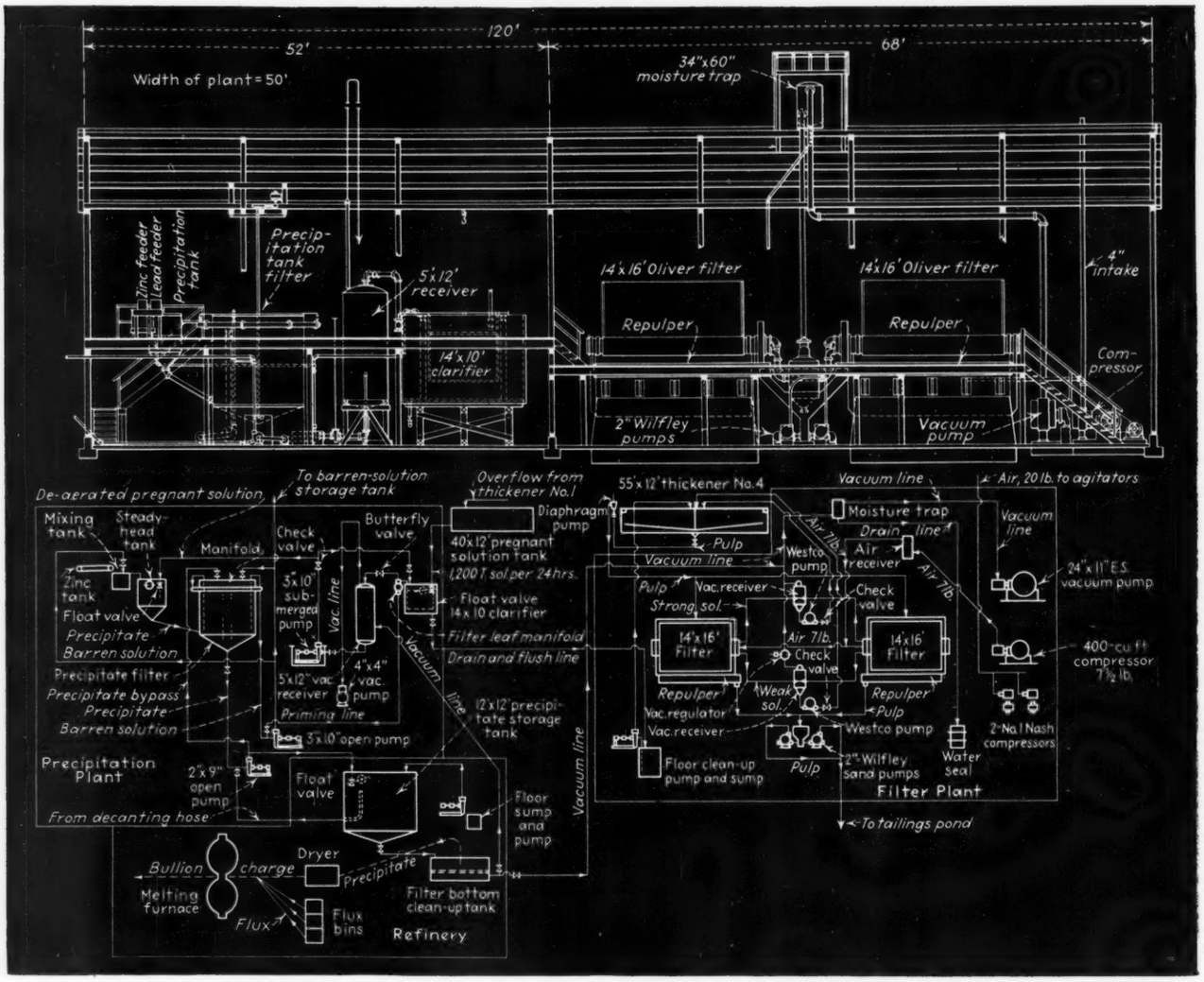
Overflow of this thickener is laundered in a 6-in. pipe having a slope of ⅛ in. per foot to a measuring weir, from which it discharges into a 40 ft. diameter by 12 ft. pregnant-solution storage tank, of a capacity of 110,000 gal. The tank is situated so as to provide a minimum static head of 8 ft. above the clarifier filter in the precipitation plant.

Underflow from the thickener, at a density of 1:1, is pumped by a 4 in. Triplex Dorrco diaphragm pump, driven by a 5-h.p., 52-r.p.m. motor reducer, to No. 1 agitator, whence it flows by gravity to No. 2 and thence to No. 3 agitator. Sufficient mill solution is added at No. 1 agitator to raise the dilutions

LAYOUT OF THE CRUSHING AND CYANIDING SECTIONS

of the Golden Queen mill. Final design called for a plant capacity of 300 tons per 24 hours, but 50 tons' additional capacity was provided to take care of possible purchases of custom ore. Capacity can be still further enlarged





to 2:1. All three agitators are 34 ft. dia. by 24 ft. Dorr machines. The volume of these agitator tanks is 19,850 cu.ft. total, which with a pulp of 2:1 (sp.gr. 1.27) equals 48 hours agitation for the three agitators, assuming there is no short circuiting of solution. The rakes for each agitator are driven by a 5-h.p., 750-r.p.m. motor through a Tex-Rope drive and worm gear.

Air for operating the agitator air lifts is furnished at 20-lb. pressure by two Nash No. 1 Hytor rotary compressors, each driven direct by a General Electric 20-h.p., 1,500-r.p.m. motor. The capacity of these compressors is 142 cu.ft. per min. each at 30-lb. pressure.

Overflow from agitator No. 3 is laundered to the feed well of thickener No. 2. Overflow of this thickener discharges into an 8 ft. diameter by 8 ft. sump tank, from which it is pumped to the mill solution storage tank by one of two 3-in. 300-g.p.m. split-casing centrifugal pumps, each of which is driven direct by a 15-h.p. motor.

The mill solution storage tank, which is set high enough to supply solution to the grinding department by gravity flow, is a 30 ft. diameter by 20 ft. tank, of a capacity of 100,000 gal.

THE FLOW DIAGRAM

is that of the precipitation, filtering and refining sections of the Golden Queen mill. Above it is shown a longitudinal elevation of the precipitation and refining sections

Underflow from thickener No. 2 at 1:1 dilution is pumped by a Dorrco diaphragm pump to a launder feeding a 24 in. by 20 ft. Simplex Dorrco repulper, which is driven by a ¾-h.p., 135-r.p.m. motor reducer, and which discharges into the feed well of thickener No. 3.

Overflow from thickener No. 3 flows by a 6-in. pipe launder, slope ⅛ in. per foot, to the feed well of thickener No. 2. Underflow from thickener No. 3, at 1:1 dilution, is pumped by a Dorrco diaphragm pump to a launder feeding a second Dorrco repulper, which discharges into the feed well of thickener No. 4.

Overflow from thickener No. 4 flows by 6-in. pipe launder, slope ⅛ in. per foot, to the launder feeding repulper No. 1, where it is mixed with the pulp from thickener No. 3. Underflow from thickener No. 4, at 1:1 dilution, is pumped by a Dorrco diaphragm pump which discharges into a launder, of a slope of ¾ in. per foot, that runs to a splitter and thence to the feed points of the two pulp filters.

Thickeners Nos. 2, 3, and 4 and their respective Dorrco pumps are the same in all respects as thickener No. 1, previously described. The thorough mixing accomplished in the repulpers is expected to affect extraction considerably.

Filtering, Tailings Disposal and Precipitation—The filtering and precipitation departments are housed in a wood-frame building, 30x120 ft., covered with corrugated iron and having concrete floors and footings.

The pulp from No. 4 thickener at 1:1 dilution is fed to two 14-ft. diameter by 16 ft. Oliver continuous drum filters equipped with washing sprays. Approximately 75 tons of water (18,000 gal. total at 12½ g.p.m.) will be used for washing each day. It is arranged so that this water is passed through the jacket of the compressor supplying the air for blowing the filters, before reaching the sprays. By this means the compressor is cooled without wasting water and the efficiency of the wash is somewhat increased due to the warm water used for spraying. The drum of each filter and

the agitator on each filter is driven by a 2-h.p. motor and reduction. The vacuum required for filter operation is maintained by a 24x11-in. Ingersoll-Rand single-cylinder vacuum pump, driven through a Tex-Rope drive by a 60-h.p., 1,000-r.p.m. motor. Filtrate is drawn off into two receivers from two sectors of the filter drum, one being strong and one weak cyanide solution. Each of the filtrate receivers is discharged by a 2½-in. Westco turbine-type pump, driven by a 5-h.p., 1,500-r.p.m. motor. Discharge from these pumps joins and is delivered to the launder feeding Dorrco repulper No. 2, at thickener No. 4, where it is mixed with the pulp from thickener No. 3.

Filter Cake Repulped

The cake from each filter, which will contain about 25 per cent moisture, is discharged into an Oliver repulper, driven by a 3-h.p. motor at 1,500-r.p.m., through a Tex-Rope drive and worm-gear reducer. A minimum amount of water is added in the repulper to provide a flowing pulp. Overflow from the repulper, which is estimated to be about 65 to 70 per cent solids, will run to a 3x3-ft. sump, from which it is pumped by a 2-in. Wilfley sand pump, driven through a Tex-Rope drive by a 15-h.p., 1,500-r.p.m. motor. This tailings pump discharges to the tailings pond through 4-in. O. D. welded casing. Provision is made for extending and changing the position of the discharge of this line to provide distribution.

Compressed air at 7½-lb. pressure and 150 cu.ft. per minute is supplied for blowing the filters. An additional 75 cu.ft. per minute from the same machine is piped to the grinding department, where it is used on the Dorr bowl classifier to aid classification in the bowl. This machine is a 225 cu.ft. Ingersoll-Rand Type MLPT compressor, driven through a Tex-Rope drive by a 20-h.p., 1,000-r.p.m. motor.

A sump, 3x7x6 ft. deep, is provided in the floor for collecting spills and floor wash, which is pumped by a 2-in. centrifugal pump, driven by a 3-h.p. motor, to thickener No. 2.

Unclarified pregnant solution flows by gravity from the 40 ft. diameter by 12 ft. storage tank to a 14 ft. diameter by 10 ft. steel tank clarifier. This clarifier consists of 26 rectangular filter leaves submerged in solution and attached to a common manifold. A Merco-Nordstrom cock operated by a float keeps the level of the solution constant in the clarifier.

The manifold of the clarifier is connected to the top of a 5 ft. diameter by 12 ft. vacuum receiver, in which the vacuum is maintained by a 4x4-in. P6-SB Chicago-Pneumatic vacuum pump driven through a Tex-Rope drive by a 1-h.p., 1,500-r.p.m. motor. The receiver is provided with a series of wooden grids in the upper portion, over and through which the incoming clarified solution is made to trickle in comparatively thin films. The extraction of air from solution is much more complete when the solution is presented with the maximum amount of surface. The level of solution in the receiver is controlled by a float inside, which operates through a lever a butterfly valve in the incoming line from the clarifier.

Clarified and deaërated solution is withdrawn from the receiver by a 3x10-in. Krogh pump which delivers to a small tank with a cone bottom known as the "steady head tank." A float-operated Merco-Nordstrom valve on the pump discharge line controls the level of the solution in this tank and the precipitate filter which the latter feeds. The 3x10-in. Krogh pump is kept submerged in solution so as to prevent any possibility of reabsorption of oxygen which would interfere with precipitation. The pump is driven through a Tex-Rope drive by a 10-h.p., 1,500-r.p.m. motor.

A Merrill self-contained belt-type zinc feeder, driven by a ½-h.p., 83-r.p.m. Master special worm-geared motor, is provided. This feeder has an 8-in. belt arranged to travel at the rate of 5 ft. in 8 hours. Zinc dust is spread on this belt to the proper depth to furnish the amount required at this speed.

The zinc dust drops from the feeder into a small tank 2 ft. 4 in. in diameter by 2 ft., fed with barren solution from the barren-solution pump. The mixture is kept agitated by a paddle agitator driven from the zinc feeder, and overflows into the steady head tank previously described.

Treatment of Precipitate

The precipitate filter consists of a steel tank 10 ft. 2 in. in diameter by 12 ft. 2 in. deep, with a flat cone bottom. A metal tube about 2 ft. in diameter is held in position with its bottom above the bottom of the tank and its top below the surface of the solution in the filter. Inside the tube is a shaft driven from above by a 5-h.p., 250-r.p.m. Master geared motor and Tex-Rope drive. On this shaft are mounted two propellers, which cause the solution in the tank to rise through the tube, thus maintaining circulation. A baffle plate above the top of the tube and below the surface of the solution deflects the rising current and so prevents any ebullition at the surface which would serve to entrap air. The propellers and shaft revolve at 120 r.p.m.

Surrounding the central tube and arranged radially are 24 rectangular filter leaves, connected to a common circular manifold surrounding the tank. The precipitate filter is connected at a point at one side near the bottom with the bottom of the steady head tank, through which it is fed. The float in the latter tank controls the solution level in both.

In the operation described, the circular manifold of the filter is connected to the suction side of a 3x10-in. Krogh centrifugal pump driven through a Tex-Rope drive by a 10-h.p., 1,500-r.p.m. motor. Barren solution withdrawn through the filter leaves is elevated and discharged into a 30 ft. in diameter by 20 ft. barren-solution storage tank, which is set at such an elevation as to permit delivery of solution to any point in the circuit from thickener No. 1 down, by gravity flow. At present this solution flows to the launder connecting with the Dorrco repulper No. 2, situated at thickener No. 4.

A 2x9-in. Krogh centrifugal pump, driven through a Tex-Rope drive by a 3-h.p., 1,500-r.p.m. motor, is connected to the bottom of the cone of the precipitate filter, from which it withdraws precipitate in solution and delivers it to the refinery precipitate storage tank.

Refinery Practice

The Refinery—The refinery is a 30x40-ft. building located to the east and in line with the filter-precipitation building. The lower half of this building is monolithic concrete, with barred windows. Its upper half is steel frame with corrugated iron covering. A rolling steel door is provided for entrance, with a Klaxon alarm connected. A vault is provided inside for storing precipitate.

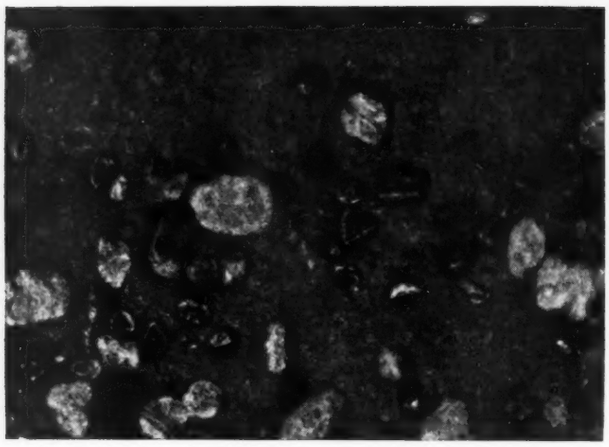
The precipitate storage tank is a 12 ft. in diameter by 12-ft. steel tank having a flat cone bottom. The level of solution is maintained by a float-operated Merco-Nordstrom cock on the discharge line of the 2x9-in. Krogh pump which supplies the tank. A decanting hose is provided inside. This is connected with the suction line of the Krogh pump, and the decanted solution is bypassed back to the precipitate filter. This tank is set high enough so that precipitate can be drawn by gravity into an 8 ft. diameter by 3-ft. clean-up tank having a filter bottom. The bottom is connected to both the 4x4-in. and the 24x11-in. vacuum pumps. The former is used for the initial filtering and the latter for finishing.

Precipitate cake is removed by hand to a 4x5-ft. electric dryer with thermostatic control. The dryer has ten 1,000-watt heating elements. The dried precipitate is stored in the vault until sufficient is accumulated for melting.

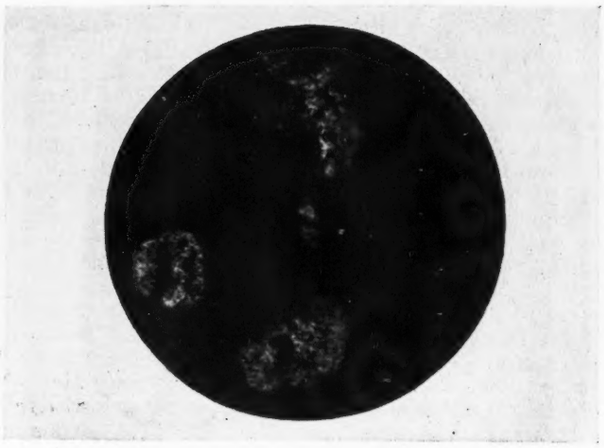
Precipitate melting is done in an oil-fired No. 1 duplex Rockwell rotary melting furnace. Oil is supplied under pressure by a gear pump driven by a ¼-h.p. motor. Air is furnished by a 4-in. blower direct-connected to a 3-h.p. motor. It is expected there will be about 160 lb. of precipitate per day containing about 110 lb. of gold-silver bullion.

A small floor sump is provided in the refinery, with a 1-in. centrifugal pump driven direct by a 1-h.p. motor. This delivers floor wash to the precipitate storage tank.

Precipitation and refining arrangements follow the latest Merrill-Crowe simultaneous clarification precipitation process.



PLACER GOLD with particles of magnetite in wax mount at a magnification of 110 X. "Ultraopak" lens system. Particles of gold range in size from 65 mesh to 2300 mesh (theoretical)



GOLD PARTICLES from the same field shown in the accompanying cut magnified 250 times. The particles range in size from slightly less than 200 mesh to approximately 2300 mesh (theoretical)

Mounting Flotation Products For the Microscope

A simple method for operator and laboratory researcher

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TODAY it is universally recognized that consideration of the physical characteristics of mineral surfaces when selecting processes for ore treatment is of importance. This applies, in its broadest sense, to flotation, because of the enormous tonnage of ore treated by this process, and it applies with equal truth to the treatment of gold ores by cyanidation and amalgamation.

Acceptance of the facts regarding the surface characteristics of minerals emphasizes the need for a simple and practical method of mounting small mineral grains, which can be used by operator and laboratory researcher with equal facility. The method here described meets these requirements and has the additional advantage of enabling the observer to use high magnifications in his studies and, if need be, to make photographic records of surface conditions as shown at critical magnifications. The binocular microscope has been generally relied upon in obtaining information relative to the surface condition of mineral grains in the crushed form, but its limitations of magnification and the difficulties experienced in securing adequate lighting conditions, such as are necessary for critical study, materially restrict its field of application. This is especially pronounced in making examinations of mineral grains of the smaller sieve sizes and beyond.

The device employed in mounting mineral grains for the purposes indicated is ridiculously simple and can be made by anyone. It consists of a piece of brass tubing 1 in. in diameter by 1¼ in. long and a cylindrical section of hardwood, such as a piece of broomstick handle, 3 in. in length. In making the device, the brass tubing should be cut carefully at as nearly right angles to the length as is possible and the ends ground to a perfect plane on a piece of emery cloth on a flat surface. The interior of the cylinder is ground smooth with fine carborundum applied to a plug of cloth or waste fastened to a stick; steel wool will answer the purpose also. The hardwood plunger should be turned in a lathe and sanded to an easy fit in the cylinder to insure ease of operation when in use.

In mounting mineral grains the procedure is as simple as the device employed for the purpose. The material to be examined—concentrates, tailings, or other—is first spread on a plane surface, preferably glazed cardboard, in a layer one particle thick. This is readily accomplished by placing the sample to be mounted in a watch glass and distributing it over the surface of the mounting board by inclining the watch glass slightly and gently tapping the edge of the glass with a pencil. The distance from the watch glass to the mounting board will govern to some extent the distribution of the particles on the mounting board and also the distance between them. It is advisable to work only with uniformly sized samples, thereby insuring a more uniform distribution of material for study and also precluding the difficulties attendant on examining a wide variety of sizes in one mount, with the unavoidable superimposing of very small particles on surfaces of larger ones.

Inasmuch as it is desired to examine as much surface as possible, the particles are oriented on the mounting board by gently tapping on the underside with a pencil. This causes the particles to rebound slightly from the surface of the board and eventually to lie on its face with their flat cleavage or crystallographic surfaces in contact with it.

The next procedure is to mount the sample for examination, which is accomplished in the following manner: The wooden plunger is inserted into the mounting ring about one-half inch, and the remainder of the space is tightly packed with "Plastine"[1] modeling clay. Excess clay projecting from the end of the cylinder is cut off with a knife, the mounting chamber inverted on a perfectly flat surface, and pressure applied to the plunger to produce a surface free from holes

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[1]Plastine can be obtained from dealers in microscopes and must not be confounded with the more oily clays available at art-supply stores.

or depressions and approximately smooth and plane. The actual mounting of the sample is accomplished by inverting the brass tube so that the clay surface is down, and then pressing this surface against the mineral grains oriented on the mounting board, thus embedding them in the clay surface.

Pressure should be applied to the pestle to pack the clay closely around the imbedded mineral grains. The mount is now ready for examination, and, after withdrawing the plunger, may be placed on the stage of a binocular or metallurgical microscope at the option of the operator. If the Leitz or Bausch & Lomb inverted-type metallographs are used for the purpose, the mounting ring should be of a diameter to correspond with the opening of the glass stage, to obviate the need of sliding the mount across the stage, which will "smear" the faces of the mineral grains. If Plastine modeling clay is used and the mounting procedure, as described, has been carefully followed, the faces of the mineral grains will be flush with the surface of the clay and also at an angle of 180 deg. to the axis of the microscope. Such grains as have slight curvature of surface may be studied by making a small adjustment of focus.

After completing the examination of all the surfaces in the mount, the plunger is inserted, and about one-sixty-fourth inch of clay is extruded. This extruded portion contains the imbedded grains that have been studied and is removed by slicing with a knife and is preserved in briquet form for further reference or study if desired. Another mount may now be prepared in the same manner as the first, and as many mounts can be made as are desired. Assuming that each mount or extrusion is approximately one-sixty-fourth inch thick, approximately sixty distinct mounts may be made of a given sample with one filling of clay. When a very small amount of material is available, as in the examination of gold particles in a tailing, it may be necessary to place each individual grain on the surface of the clay and imbed it by applying slight pressure with a clean instrument. Particles imbedded in this manner will adhere to the clay tightly enough to remain in place when the mount is inverted for study on the metallographic microscope, but it is more difficult to orient them plane to the axis of the microscope. Practice and skill on the part of the operator are required in mounting single grains, especially if photomicrographs at high magnification are required.

The study of surface characteristics of small mineral grains at high magnifications by the procedure described greatly extends the field of possibilities in this branch of microscopic research and constitutes a valuable tool for acquiring factual data that can be obtained in no other way. The simplicity of the entire procedure should appeal to workers interested in this particular phase of mineralogical investigation.

Testing Placer Ground In a Unique Way

Three trenches, each representing a dragline cut, are dug with a pull shovel and the material is sluiced

Paul L. Jones

Assistant Manager
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WHILE TESTING certain placer deposits in Wyoming this year our small staff of technicians found what we believed to be an unusual condition which required something different from the ordinary in testing technique. The bedrock was composed of a gray decomposed granite, which was soft and lay in waves, the crests of which were 5 to 15 ft. apart, running at right angles to the present stream bed. The concentration of gold was found for the most part not more than 12 in. above bedrock, the heaviest part of this occurring on bedrock just over the crest of the wave on the downstream side. The upstream slopes and the depressions between the wave crests carried little if any values.

In attempting to sample this deposit with test pits we found that we either had exceptional values or none at all, depending on whether or not the pit reached bedrock on the crest of one of these waves or in the depression between them. We reached the conclusion that to get a true appraisal of the ground by this method would require an excessive number of pits that would be put down at great expense, inasmuch as the ground was very wet and each pit required pumping.

Due to the lay of the ground, the depth to bedrock, and the water conditions, we had decided that the logical way of working the area, should sufficient values be found there, would be to use a dragline dredge. With this in mind, we decided to duplicate the operation of the dredge as nearly as possible on a very small scale.

In studying the ground that we thought was gold-bearing we found that we could make three cuts with the dredge, each 90 ft. wide, which was the limit for the 45-ft. boom we were using on the dragline. We decided, therefore, to start the testing by digging three trenches, one on each side, 45 ft. from the outer boundary, and one in the center of the deposit. These were each 100 ft. long, each trench representing a cut of the dredge. The trenches were so staggered that the finish of one would be opposite the beginning of the other. They were located and staked, or marked for the entire length of the deposit.

The dredge would have to dig under water, so we decided to dig the trenches under water, and to put the material thus removed over sluice boxes, containing riffles such as those we expected to use on the dredge. This, we thought, would give us a fair idea of the values we could expect to save.

Inasmuch as we anticipated doing much of this kind of testing in this district, we set about devising some mechanical means of excavating the trenches. After considering possible equipment we selected a pull scoop, or trench hoe, of ¾-cu.yd. capacity, mounted on caterpillar tracks. This we thought would not only do the job, but would also have a general utility value should the ground prove to be worth working.

Our next problem was to design a washing plant that was light enough to be moved by the pull scoop and rugged enough to stand the abuse. It also had to have capacity sufficiently large to cut the cost of operating to a minimum. We accomplished this by mounting a 4x5-ft. steel hopper on skids. The mouth of the hopper was covered by a 1-in. grizzly mounted on a slope sufficient to eliminate the oversize material by gravity. The fines passed through the hopper into a steel sluice box 18 in. wide and 24 ft. long. Water for washing on the grizzly, as well as for sluicing, was furnished by a 3-in. centrifugal pump. The water was pumped from the nearest available source, usually from that part of the trench which had been completed.

Sluice boxes were cleaned carefully upon the completion of each 20 ft. of trench. The completed section was carefully measured as to width, depth, and length, and the yardage was calculated and recorded. The panned concentrates taken from it were placed in jars and labeled, showing the number and section of the trench, the yardage, changes in formation if any, depth to bedrock, and any other information which might prove of value later. At the end of the day, the panned samples were carefully amalgamated, and the amalgam was dissolved in nitric acid, cleaned, dried, and weighed. Following this procedure, we were able to figure closely the average value per cubic yard of any trench or section thereof. All of this information was carefully noted on a map, which had been prepared at the beginning of the testing

work, and showed the location of each trench in detail. By consulting this map, it would be an easy matter to lay out the course of the dredge, and move only that material which could be handled at a profit.

Interestingly, it turned out that the dredge recovered half a cent more per yard than the tests detailed in the report showed.

This equipment was moved on its own power, dragging the washing plant over a distance of 50 miles during the summer, with no expense other than that of gasoline and oil. The cost of moving and washing the material from the trenches, exclusive of depreciation but inclusive of the cost of cables, bucket teeth, repairs, gasoline, oil, grease, and labor, was 62.75c. per yard. I venture to say that had we used hand labor for this job our costs would have been much higher, not to mention the time which was saved on the testing job.

AT THE PORTAL of the Treasury Tunnel in the Red Mountain District of Colorado. The lake is fed by water from the tunnel

Oxygen Deficiency Underground

Some instances of bad air in mines

Robert S. Moehlman

BAD AIR is found in many mines of the Red Mountain district, south of Ouray, Colo. As an example, the Treasury Tunnel, situated halfway between Ouray and Silverton, on the Million Dollar Highway, at an elevation of 10,700 ft., may be taken. It extends 5,500 ft. into the mountain and terminates in a dead end. Constant ventilation is necessary while work is being carried on. Gas is noticeable within 24 hours after its cessation. A sample of this air was taken by me from a raise driven from the tunnel and has been analyzed by F. D. Tuemmler, at Harvard University.

In physical characteristics, the mine gas is lighter than air, so that it rises toward the top of raises as the mine is ventilated. It is non-inflammable, a carbide lamp being immediately extinguished in it. A miner can work in it only a few minutes without becoming unconscious.

The composition of the gas as determined by Mr. Tuemmler is given below (in percentage by volume) along with the average composition of the atmosphere.

	Air of Treasury Tunnel %	Average Atmosphere %
Carbon dioxide	0.98	0.03
Oxygen	3.80	21.0
Nitrogen	95.22	78.1
Argon	.....	0.9

Inasmuch as the percentage of nitrogen was obtained by difference, some other inert gas, such as argon, may well be present in the sample analyzed. Carbon monoxide and helium were sought but not found. Methane appeared to be present in one test, but a careful check test gave a negative result.

The mine gas is thus composed of the same elements as ordinary air and differs only in proportions. It might be thought that the gases would rapidly diffuse and mix so that the oxygen-nitrogen ratio would be nearly the same in spite of differences in density. Actually, the contacts are very sharp: when the bad air was being sucked out of a raise by a ventilating pipe, a carbide lamp would burn brightly close to the pipe opening, but when raised a few inches it would instantly be snuffed out.

Apparently, nitrogen has been added to or oxygen has been subtracted from the mine air; the latter alternative is far more likely. The Treasury Tunnel is a wet mine and contains fairly heavy sulphides. Oxygen may be taken from the air as the sulphides oxidize. Also, oxidation of sulphides in the ground above the mine may produce ferrous salts, which are carried downward by the groundwater, subtracting oxygen from the mine air on passing into the ferric state.

Oxygen deficiency in the air of metal mines has been the object of considerable study by the United States Bureau of Mines. Tests made on samples of rock from Cripple Creek demonstrated that the gases formed as a result of interaction of rock, air, and water. The tests were made by sealing samples of crushed rock in glass carboys with water; in a sample of brecciated vein material containing considerable sulphides, the oxygen content dropped from 20.9 to 7.2 per cent in 24 days.

Occurrence of mine gas has been found to be related to barometric changes; at times of low pressure, gas flows into the mine workings. "In one occurrence investigated by the Bureau of Mines at Cripple Creek, air samples collected by a vacuum bottle showed less than 0.3 per cent oxygen, 18 per cent of carbon dioxide, and 81 per cent of nitrogen, although the air in this same shaft had been entirely free of gas a few hours before. One idle mine of considerable extent was entirely free of gas during good weather, but when a storm arose the mine filled with carbon dioxide and nitrogen so that the light of a carbide lamp was extinguished 20 ft. from the portal."

Lack of a specific poisonous gas in the air does not imply that the miner breathing this air is not subject to some risk. The Bureau of Mines recommends that mine air be considered unfit if it contains less than 19 per cent oxygen; a lighted candle is extinguished when oxygen falls below 17 per cent. "Work may be continued in air containing less than 17 per cent, but below 13 per cent the blood is unable to obtain oxygen fully; when the oxygen content of the air drops much below 10 per cent judgment is impaired and delirium may follow. Under certain conditions unconsciousness is the result, and when the oxygen content is less than 5 per cent, paralysis follows quickly. Generally when a man goes from good air to an atmosphere very deficient in oxygen, he drops almost instantly, without warning. A lighted carbide lamp is extinguished when the oxygen in the air falls below approximately 13 per cent.

Lithium
In North Carolina

Spodumene pegmatites near Kings Mountain, in the Piedmont, offer a supply of easily secured mineral which possibly can be concentrated by simple means . . . . A wider demand imminent.

Frank L. Hess
Principal Mineralogist
United States Bureau of Mines
Washington, D. C.

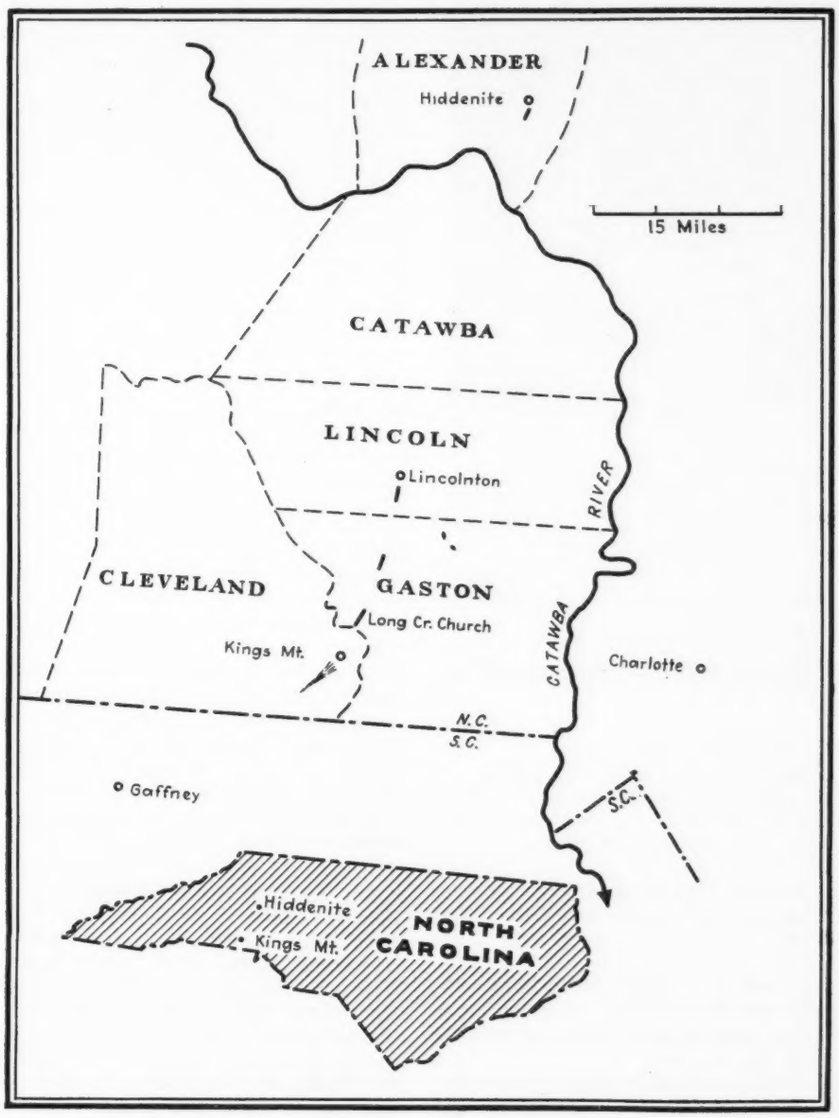

Fig. 1 . . . SPODUMENE PEGMATITES
that are known to occur in North Carolina are indicated on this map. They are found in four counties

PEGMATITES rich in spodumene, one of the principal sources of the world's supply of lithium, occur near Kings Mountain, in North Carolina, in bands up to a half mile in length, 3 to 125 ft. in width, if not wider, as well as in large masses. The occurrence of spodumene, the lithium aluminum silicate ($Li_2O.Al_2O_3.4SiO_2$), in this vicinity[1] has been noted in publications by Graton[2] and by Keith and Sterrett,[3] but in neither publication was the mineral considered as of probable value, and the records have been almost unnoticed.

Although great numbers of pegmatites, some of which carry unusual minerals, are known in the Piedmont and along the southern Appalachians, lithium minerals have been noted in few of them and hitherto only in small quantity. A little lepidolite, the lithium mica, has been found near Amelia Court House, Va., and less certainly at several other places.

In 1881 hiddenite, the emerald-green spodumene, was described from Alexander County, N. C.[4] 50 miles N. 20 deg. E. of Kings Mountain and the mineral gave its name to a post office at that place. Several years ago a small handful of purplish spodumene (kunzite) in crystals of almost gem quality were found near Spruce Pine, N. C. So far as I know, no other occurrences of spodumene in the southern Appalachians have been noted in the literature, though Dana[5] quotes the existence of spodumene at Ballground, Ga., but I can find no confirmation and it seems probable that someone may have mistaken broad-bladed white kyanite for the lithium mineral. Under certain conditions, the two minerals look remarkably alike, both in hand specimens and under the microscope.

Owing to possible much larger use

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of lithium salts, O. C. Ralston and I examined the deposits near Kings Mountain preliminary to his undertaking experiments on extraction of the lithium, and at that time the data on which this article is based were collected.

In 1905 Graton noted a mineral at the Faire's mine which he thought might be triphylite.[6] He also noted lepidolite, and purpurite,[7] a weathering product of triphylite. At this late date I have been unable to find any of these minerals in the dump or pegmatite at the old workings.

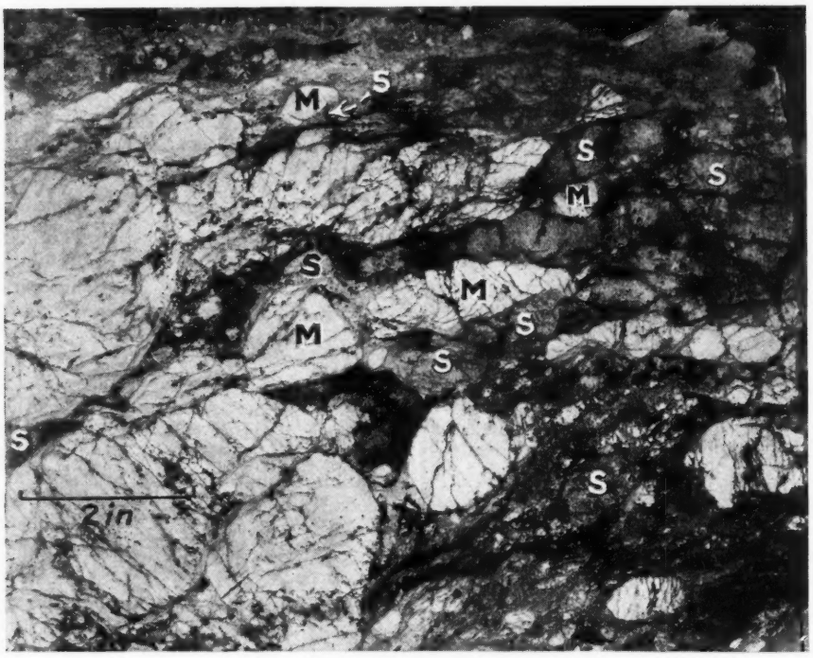

Fig. 2 . . . FRAGMENTS

of microcline (M) rounded through replacement of the corners by fine-grained albite, quartz and muscovite and later replaced by spodumene (S). Photo by U. S. National Museum

When compared with the lithium deposits in New England, New Mexico and California, and especially in South Dakota and Manitoba, the deposits of the southern Appalachians as hitherto known have seemed insignificant, but a re-examination of the pegmatites near the town of Kings Mountain with interest focused on their spodumene content has given a considerably different idea of their relative importance.

Geology—The area under consideration (see Fig. 1) is in the Piedmont and is rolling peneplain, mostly between 900 and 1,000 ft. above sea level. Above the peneplain, "mountains" such at Kings Mountain and Henry Knob rise as much as 800 ft. above the general level, and there are a number of less prominent ridges.

According to Keith and Sterrett,[8] the principal rocks of the area around Kings Mountain are the Carolina gneiss, Roan gneiss, and Battleground schist, all Archean, into which is intruded the late Carboniferous (?) Whiteside granite.

This sounds comparatively simple, but notice the definitions:

"Roan gneiss. Chiefly hornblende schist, hornblende gneiss, schistose diorite and diorite; in places intercalated with layers of mica schist, mica gneiss, garnet schist, and garnet gneiss; intrusive into Carolina gneiss. In places closely injected by Bessemer granite."[9]

The Carolina gneiss is not much simpler. It is made up of

"Interbedded gneisses and schists, including mica gneiss and mica schist, garnet gneiss and garnet schist, kyanite gneiss and kyanite schist, staurolite schist, marble beds and some granitoid layers."

But the Battleground schist is somewhat less of a scrap heap. It is said to be

"Chiefly gray, bluish black, and mottled white and bluish sericitic schist, with manganese schist member at top and conglomerate bed near base."

It also contains staurolite schist.

Pegmatites are said to cut both gneisses and the Bessemer and Whiteside granite, but apparently the Bessemer granite does not reach as far west as the spodumene-bearing pegmatites.

The strike of the rocks follows the trend of the Appalachians. Five or six miles southwest of Kings Mountain the strike is about northeast, but nearer the town it gradually changes to about N. 20 deg. E., and in general the pegmatites follow the strike of the country. The dips are high, from 60 to 80 deg. northwest. Kings Mountain has much the same position with regard to the spodumene pegmatites as the pivot supporting the beam of a platform scale; there is a much greater length of beam on one side than on the other, but it is to be noted that the shorter end carries the greater weight.

In this locality the rocks are very deeply decayed. At the Ross tin mine, near Gaffney, S. C., and about 19 miles southwest of Kings Mountain, some of the rocks could be cut with a spade to a depth of 125 ft.

The geology of these greatly metamorphosed rocks would be difficult to unravel even if unweathered and bare, and it is vastly more difficult with the heavy mantle of decayed rock ("saprolite," as it is fondly called by many who find the Greek for "rotten" more attractive than plain English).

Many of the pegmatites are decayed like the other rocks, and this seems to be particularly true where they have been composed mostly of feldspar. On the other hand, some pegmatites have outcrops of remarkably fresh and unweathered rock, though in places they seem to be much decomposed just below the surface.

The line of spodumene pegmatites begins on the Dedman farm about 3¾ miles southwest of the Kings Mountain town limit and runs almost northeast for 2½ miles. Here the general strike changes to about N. 20 deg. E. and the pegmatites multiply and spread each side of the line to a fan-shaped group that runs almost to the boundary of the town.

In the same strike several greatly decayed tin-bearing pegmatites outcrop in the town, but no more spodumene is known until Long Creek is reached, almost 4 miles northeast of Kings Mountain. Just below the Bessemer City water-supply dam, spodumene pegmatite is found on both sides of the creek.

On the north side several masses outcrop, and a single mass 3 to 10 ft. wide runs 200 or 300 yd. northward, passing under the Long Creek Church. Five miles N. 28 deg. E. on the south side of the highway is a mound about 300 ft. long and 100 ft. wide held up by blocks of similar pegmatite, and 5 miles N. 10 deg. E. from that is another occurrence at the old Lincolnton tin mines. It is an interesting coincidence that the spodumene pegmatites also end with a tin-bearing body, though a small one, at their southwest extremity.

The tin deposits of the Carolinas, with their chimerical hopes of wealth, follow the same line of pegmatites but are in a broader belt.

So far as I have observed, in the spodumene pegmatites the tin is found nowhere with the spodumene.

The Spodumene Pegmatites — The pegmatites, as stated in the opening paragraph, are in bands as much as a half-mile long, from 3 to 125 ft. wide, and in masses with approximately equidimensional outcrops that may be 125 ft. across. In general they have resisted weathering so that they cap ridges and hilltops. They commonly weather into heavy blocks which spread over the surface so that what appears to be a single, wide body may be several narrower bodies, and it is possible that some may be wider than I have indicated in the foregoing.

The pegmatites are light-colored rocks of moderate or small grain. Their freedom from colored minerals is remarkable. Even schorl (black tourmaline), common in most pegmatites, is very scarce, though a few small crystals are found here and there. Keith and Sterrett note a quartz-tourmaline vein, near the town line, which in places is about half tourmaline.[10]

Remarkable also is the freedom from large segregations of quartz, feldspar, or mica, and likewise remarkable is the paucity of mica and phosphates, the entire absence of graphic granite, of lithium minerals other than spodumene, and of beryl.

A few films of pyrite, chlorite, and vivianite have been found and, at the end of one long pegmatite, a very few garnets.

At a number of places cassiterite has been found at the side or at the end of a spodumene pegmatite, generally where the pegmatite has been replaced by quartz and muscovite. The mica is in thin, elongated plates normal to the walls. The cassiterite is similarly elongated and oriented. Spodumene is never found in this association. In the decayed feldspathic pegmatites cassiterite replaced feldspar, and some unusual crystals have been found.

In places where the wall rocks are mica schists the mica content at the contact may be considerably increased and take the form of lenses a few inches thick and a foot or so long. Biotite in such a position is likely to carry the rare alkalis[11] (lithium, rubidium, and cesium), and it was found to be true of biotite occurring on the W. A. Ware farm. R. E. Stevens and I hope to publish a separate technical paper on this mica.

The bodies of spodumene pegmatites were originally intruded as a white, fine-grained mass of microcline, quartz, and muscovite. They have all been cracked lengthwise, and many show a little rough sheeting parallel to the strike. At constricted places the effects of the sheeting may almost reach schistosity.

Along the cracks solutions brought white microcline[12] that formed sheets which, though mostly thinner, may be 2 ft. or more thick, with an extension often of many feet along the dip and strike.

Later, other movements took place which cracked the microcline and were accompanied or followed by solutions which gnawed away and replaced the corners of the fragments, smoothing them off until they look like rolled and rounded pebbles. The commonest replacing material is quartz, largely in minute grains. With it is albite, in like small grains, and some muscovite, in thin books mostly less than a half an inch across. The aggregate looks as if, while of the consistency of oatmeal gruel, it had swirled through the cracks in the microcline and then solidified.

In this counterfeit frozen current lie small spodumene crystals. Many of them have cross-sections with curved borders, and have replaced the rounded fragments of microcline, of which larger pieces 2 in. or more in diameter are found in all stages of replacement. (See Fig. 2.)

Possibly several stages occurred in the replacement, because mere outlines mark the boundaries of some spaces once occupied by rounded microcline fragments, and the places are now filled by albite, quartz, and a little muscovite.

Only a part of the spodumene takes the form of the replaced microcline. Some lath-shaped crystals are a foot long. A few crystals are roughly 2 to 3 in. square and 18 in. long. Few show even rough terminal planes and the prisms are irregular. Occasionally a piece is found that is almost glassy and slightly yellowish green. In a few places the original pegmatite has been replaced by albite aplite. (See Fig. 3.) It contains only a little muscovite and is so fine-grained that it is almost aphanitic. Through it are tiny sheaves and sprays of spodumene crystals in part coalesced into a single larger crystal, which looks like a miniature board with frayed ends.

Some of the particles of spodumene are not more than 0.01 mm. (1/2,500 in.) in diameter, but the microscopic particles apparently hold only an inconsiderable part of the lithium. The aplite incloses tongues of microcline and apparently has replaced the pegmatite into which the microcline was introduced.[13]

In some places, such as on the southwest part of the Johnny Dixon farm, spodumene has spread from cracks and has replaced the mixture of microcline, quartz, and less muscovite which preceded both the massive microcline and the spodumene.

At Long Creek Church the pegmatite shows much of this type of spodumene. In the bottom land on the south side of Long Creek is a mass of albite aplite

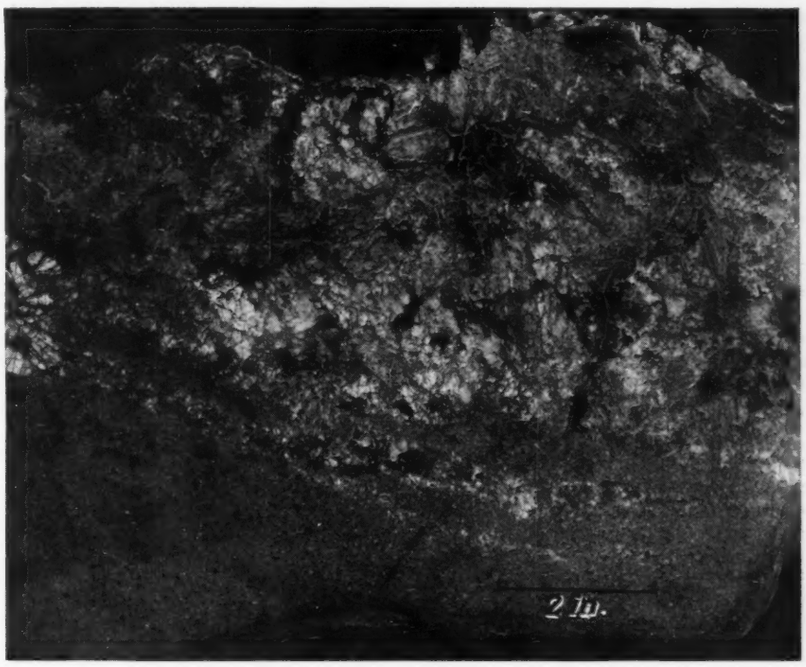

Fig. 3 . . . PEGMATITE

in which the earlier mass was replaced by microcline (nearly white) and that has been largely replaced by albite aplite (lower fine grained) and by spodumene (coarse gray and nearly black). Photo by U. S. National Museum

probably between 50 and 100 ft. wide. Through it cut veins of spodumene 3 to 8 in. wide in which the spodumene crystals bristle from the walls like quartz crystals in veins.

The aplite is intriguing. In sections for the microscope it shows quartz, albite, and muscovite in almost equal quantities but declining somewhat in the order named. It shows some gneissoid structure and typical irregular aplitic interlocking sutures—a sign that the magma was very wet. It contains no spodumene.

What was the relation of this aplite to the pegmatites before the arrival of the microcline and the succeeding spodumene? It seems possible that it may have preceded some of the pegmatite and may have been entirely replaced by it. On the other hand, it may have been intruded at the same time as the comparatively fine-grained pegmatites, which later received their additions of microcline and spodumene. If the latter, the aplite seems to have received only the spodumene in an almost if not quite unique form—a spodumene vein.

Pegmatites—Lithium—Spodumene

The Lithium Content—The lithium-bearing pegmatites are marvelously consistent in that they carry spodumene almost throughout. It is not to be supposed that they are everywhere equally rich, but in nearly all of those which carry any of the mineral it is uncommon to find a part that does not show some spodumene. The spodumene is much more evenly distributed through the pegmatites than the minerals are in most metalliferous veins.

What appeared to be representative samples have given between 15 and 20 per cent of spodumene concentrates, but there are much richer as well as much leaner parts. Analyses of the spodumene have shown 6 to 7 per cent of lithia, Li_2O, but although theory demands a content of 8.4 per cent Li_2O, very few analyses show as much as 7.50 per cent. From these considerations weathering seems to have caused little loss of lithia from the crystals in the outcropping rock, and the figures would indicate 1 to 1.40 per cent of Li_2O in the rocks, but these are merely tentative approximations.

Comparison With Other Deposits—The spodumene and amblygonite deposits of the Black Hills have furnished most of the lithium mined in the United States, although several thousand tons of lepidolite carrying about 2 per cent of Li_2O have been mined at Camp Harding, 9 miles northeast of Embudo, N. M., and probably an equal quantity from Pala, Calif.

The Etta pegmatite at Keystone, S. D., has been far the largest producer, and 36 tons of spodumene has been produced from a single crystal. The lithia content of the spodumene is about the same as that at Kings Mountain—6 to 7 per cent—but it is said that 15 tons of waste is mined for each ton of spodumene shipped.

Just south of Oreville, S. D., a spodumene pegmatite on the Hunter claims runs for a mile of more parallel with and several hundred feet above the Burlington Railroad. The pegmatite is 3 to 20 ft. wide, and the partly translucent crystals, which reach the size of a man's arm, are comparable in quantity with those in the Kings Mountain pegmatites.

A part of the great pegmatite at Tinton, S. D., carries spodumene in size of crystals, occurrence, and tenor, much like the Kings Mountain deposits.

H. C. Stockwell[14] has described a spodumene pegmatite at Cat Lake, in southeastern Manitoba, that is somewhat similar to the Kings Mountain occurrences, but the spodumene is buried in quartz. He estimates that the quartz carries 50 per cent of spodumene, and that bands of the mixture make up from 20 per cent in the leaner parts of the mass to 70 per cent in the richer parts. The spodumene is accompanied by albite aplite. It is reported that spodumene from this region is now being imported into the United States.

Working Methods—So much of the spodumene-bearing rock lies on the surface of the ground and is available in protruding outcrops that hundreds of tons of lithium salts could be produced without digging. Should exploitation be undertaken it would seem to be well to buy the loose rock delivered at a mill rather than to mine it at some particular place.

Metallurgy and Uses

Concentration—The specific gravity of the spodumene is about 3.25 and that of the gangue (quartz and feldspar) about 2.65. The difference between the specific gravities, 0.6, seems great enough to make possible the concentration of the mineral on ordinary shaking tables. However, as in the Black Hills, where the spodumene crystals are known as "logs" from their size and structure, the crystals split like wood and make separation on tables difficult. Flotation of the spodumene or separation by heavy solutions may be commercially possible. Another possibility seems to be to separate the lithium as chloride directly from the crushed ore by treatment with dry chlorine, dry HCl gas, or, possibly, by a mixture of the two.

Many methods of separation of lithium from the concentrated minerals have been proposed and patented. An investigation of the general problem of separation of the lithium from rock to finished product has been undertaken by O. C. Ralston, of the United States Bureau of Mines, at the Bureau's Nonmetallic Experiment Station in New Brunswick, N. J., and concentration methods by Will H. Coghill at the Bureau's Mississippi Valley Experiment Station, in Rolla, Mo.

Uses—The most widely known fact about lithium is that it has been prescribed extensively as a cure for bodily calculi. This medication has been based on the supposition that the unchanged compounds would reach the organs carrying the calculi and there make a base exchange with the insoluble calcium salts, but lithium salts are not prescribed as frequently as they were a while ago.

Lithium (metal) has been used in fractional percentages for hardening aluminum and lead, and a lithium salt was used in the Edison storage battery, but the total consumption has of late declined.

Lithium chloride, a salt, which is so hygroscopic that it readily extracts moisture from the atmosphere, finds some use in conditioning air, and there seems to be promise of a progressively larger use.

Under certain conditions lithia is used in glass making, but it cannot be generally used to replace potash or soda. There is now a large consumption of alumina in glass, and it is possible that for making certain types of glass the concentrated spodumene, if sufficiently low in iron, may find a market.

REFERENCE NOTES

[1]Where "Kings Mountain" is mentioned in this text the town is meant and not the ridge, 3½ miles southeast, from which the town received its name.

[2]Graton, L. C.: "Reconnaissance of Some Gold and Tin Deposits of the southern Appalachians." U. S. G. S. Bull. 293, 1906, pp. 23, *et al.*

[3]Keith, Arthur, and Sterrett, D. B.: Gaffney-Kings Mountain Folio. U. S. G. S. Geol. Fol. 222, 1932.

[4]Smith, J. Lawrence: "Hiddenite an Emerald Green Variety of Spodumene." Am. J. S. (3) v. 21, pp. 128–130, 1881.

[5]Dana, J. D., and E. S.: A System of Mineralogy. Sixth edition, 1892, p. 368.

[6]Work cited p. 38.

[7]Graton, L. C., and Schaller, W. T.: "Purpurite a New Mineral." Am. J. S. (4) v. 20, 1905, pp. 146.

[8]Work cited. Map showing areal geology.

[9]*Loc. cit.* Legend on map entitled "Areal Geology."

[10]Work cited, p. 11, col. 3.

[11]Hess, Frank L., and Fahey, J. J.: "Cesium Biotite From Custer County, South Dakota." Am. Mineralogist, v. 17, 1932, pp. 173-176.

[12]This feldspar has approximately the indices of microcline ($\alpha = 1.518$ $\gamma = 1.525$-1.526) but shows no perthitic structure, and is the only large potash feldspar without this structure that I have seen in pegmatite.

[13]Large specimens showing the features described have been deposited in the United States National Museum.

[14]Stockwell, H. C.: "Lithium Deposits." Canada Geological Survey, Mem. 169, 1932, pp. 124–126.

An Investigation of Gold Loss In Roasting Arsenopyrite Concentrate

To secure good results the arsenic must be volatilized at a low temperature

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WHILE CONDUCTING certain experimental work in the summer of 1935, I encountered a problem concerning the treatment of a refractory concentrate consisting largely of arsenopyrite. This material was most refractory, and several methods were attempted to make it amenable to cyanidation. These included very fine grinding, bromo-cyaniding, the use of mercury salts, and extreme aëration and agitation. Various combinations of the above were also tried, but with no success, the best extraction being less than 20 per cent. The conclusion drawn from these failures was that the gold in the concentrate existed in some state in which it was chemically or physically bonded to its host mineral in such a manner that cyanide could not dissolve it. As a last resort roasting was attempted and the product was cyanided. This gave encouraging results. Owing to the lack of adequate facilities, the roasting was at best very inefficient. We noted, however, that a loss of gold apparently occurred due to the roasting. This loss was not investigated at that time.

In the following a report of an investigation conducted on this same material is presented, the object being to determine the amount of gold lost by roasting. The results are rather surprising and should be of interest and value to metallurgists and assayers.

The sample used in this investigation weighed 43 lb. It consisted of a flotation concentrate and arrived wet. It was carefully dried, every precaution being taken to avoid oxidation. The lot was then carefully sampled in the regular manner and a 7-lb. sample obtained for the experimental work. Analysis of the concentrate is given in Table I.

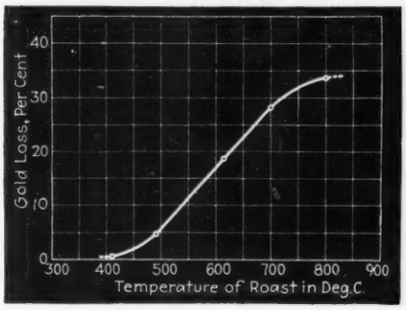
The 7-lb. portion was carefully sampled and assayed. In consideration of the future importance of this assay value, eight assays were run. In the results, one erratic was found, the balance being within 1 per cent of the mean value. This head assay, in gold, was 3.91 oz. per ton.

Samples for each run weighed 150 grams. A gas-fired muffle was used, which was brought up to the desired temperature before charging the roasting dishes. Every run was done in duplicate. The temperature was recorded every five minutes and the average calculated. The temperature used was that of the atmosphere of the muffle directly above ($\frac{3}{4}$ in.) the roasting dishes, and was read from a thermocouple pyrometer. Roasting was continued in every test until no trace of SO_2 could be detected by smell in the air above the dishes. This period of time averaged 95 min. During roasting, the charges were rabbled carefully every five minutes, great care being taken to avoid dust loss. Duplicate assays were run on the roasted product, and, knowing the weight and the assay of each dish, the loss was calculated.

This gold loss is plotted on the accompanying graph.

One complete report is given in Table III to indicate the nature of results.

After first fuming slightly with white As_2O_3, the charges gently took fire and became covered with an even bath of flame. This died down after an interval that varied from 15 to 20 min. on the low-temperature roasts to 10 min. on



GOLD LOSSES experienced in roasting arsenopyrite concentrate at temperatures ranging from 412 deg. C. to 802 deg. C. have been plotted to give this curve

Table I—Analysis of Concentrate Sample

	%		%
Fe	26.85	Sb	0.16
As	15.52	Insoluble	10.3
S	19.30	True silica	7.8
Cu	0.20		

Table II—Condensed Results of Roasting Tests

Roasting Temperature °C	Per Cent Loss in Weight	Per Cent Loss in Gold
412	30.7	0.7
491	30.6	4.5
615	30.6	18.8
700	30.8	28.1
802	32.0	33.7

Table III—Results Obtained on One Set of Duplicate Samples

	Mean Temperature 700°C		
	Sample F	Sample B	Mean
nitial assay	3.91 oz.	3.91 oz.	3.91 oz.
Original weight	150.0 gm.	150.0 gm.	150.0 gm.
Final weight	103.5 gm.	104.2 gm.	103.8 gm.
Loss in weight	46.5 gm.	45.8 gm.	46.2 gm.
Per cent loss in weight	31.0%	30.6%	(a) 30.8%
Assay after roast (i)	4.14 oz.	4.02 oz.	.....
(ii)	4.05 oz.	4.08 oz.	.....
(iii)	3.98 oz.	.....	.....
Mean assay	4.06 oz.	4.05 oz.	4.06 oz.
(1) Original weight times initial assay	.....	.....	586.50
(2) Mean final weight times mean final assay	.....	.....	421.43
Difference (1) minus (2)			165.07

Gold loss, per cent = $\frac{165.07}{586.50} \times 100 = 28.1$ per cent.

(a) The average loss in weight for the whole series of roasts was 30.9 per cent.

the highest-temperature roast. At the end of this period the charge glowed evenly on rabbling, becoming dark on the surface when left undisturbed. At 400 deg. the charge remained loose and porous throughout, but at 500 deg., and particularly at 600 deg., sintering was evident, although the chunks could be easily broken up with the rabble iron. During the roast at 600 deg. the charge became tacky after the arsenic flames had died down, some sort of fusion being apparent. This was noticed to a much lesser degree in the early stages of the higher-temperature roasts.

The SO_2 fumes evolved were detected by their smell, being given off for periods varying from 100 min. for the 400-deg. roast to 60 min. for the 800 deg. roast. The charges were left in the muffle for an additional fifteen minutes after the last trace of SO_2 was detected, to insure complete oxidation.

From the graph one may see that a decided break occurs between 400 deg. and 500 deg. The tacky property of the charge in the 500-deg. and 600-deg. roasts seems to indicate that the concentrate tends to fuse somewhere around 500 deg. C. The loss increases in linear proportions between 500 deg. and 700 deg., then falling off. In the test described, the upper limit was not found.

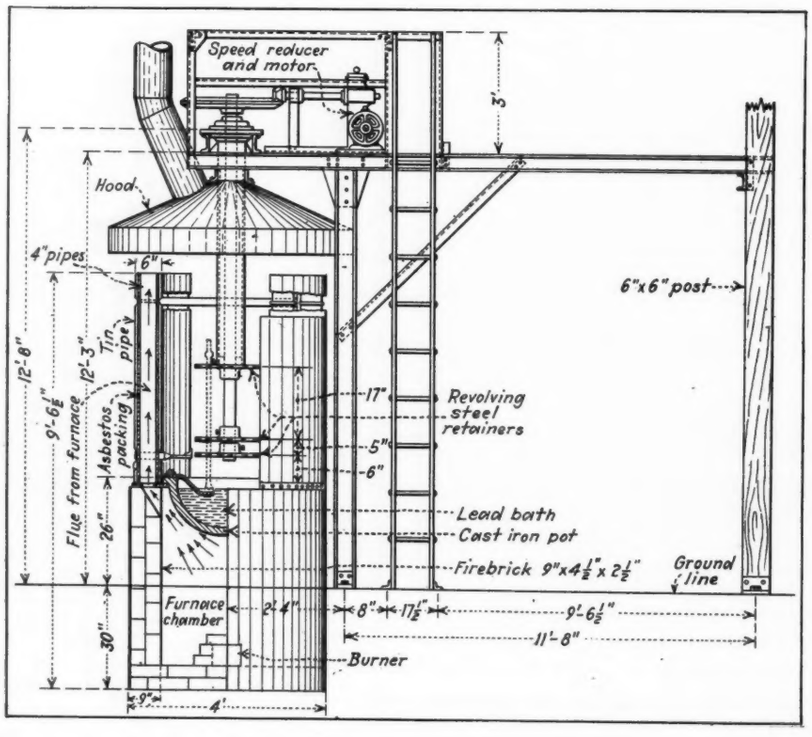
From the practical angle of one wishing to roast this material on a commercial basis, the chart has little direct value. This is obvious, in that in any roasting machine the charge is gradually raised to the final finishing temperature. This fact suggested the following test: The same procedure was followed as in the previous tests, but the temperature was kept at close to 400 deg. C. until all the flames of As_2O_3 had died down. This required about 25 min., and then the temperature was raised to 800 deg. and the roasting carried to completion at this heat for one hour. The result was a gold loss of 1.71 per cent. Thus in practice, the gold loss in the roasting machine due to volatilization with the arsenic fumes may be less than 2 per cent. However, the *rate* of roasting (that is, the rate of operation of the machine) must have a decided bearing on the amount of loss. These tests indicate that practically all of the arsenic must pass off at a low temperature, and it is reasonable to assume that if the roaster was forced, and the charge, although dead-sweet at the finish, had been subjected to temperatures above say 450 deg., before the arsenic had been driven off, the loss of gold might be considerable. This point is most important to the operator of a plant treating this type of material.

From the point of view of the assayer, the loss of gold due to roasting at high temperatures is important. This investigation shows that a mispickel concentrate may lose over 30 per cent of its gold content when roasted at a temperature below that of an assay muffle. The solution to the difficulty has been indicated on the foregoing, but more important perhaps is the obvious danger of salting pots placed in the same muffle.

Drill Steel Tempering Furnace

NEXT to proper sharpening of the drill bit, tempering is perhaps the most important phase in the reconditioning of drill steel. No matter how efficient the compressing plant and the rock drills, or how careful the drill operator, if the bit is dull or of incorrect shape, the rock is not cut, good energy is wasted, and money and time are lost in reaming the hole or in pulverizing the rock, and the real objective of the work is defeated.

Confronted with exceptionally hard ground—from 70 to 100 pieces of drill steel are required per round—and not satisfied with conventional tempering practices, W. V. DeCamp, general manager, Cardinal Gold Mining Company, Bishop, Calif., adopted the automatic lead-bath tempering furnace shown in the accompanying line cut. Of simple design and entirely automatic in operation, only one man is required to work the furnace. Its total cost was $924, including a Brown pyrometer. Capacity is 700 pieces of 1¼-in. hollow round drill steel daily gaged to 3⅜ in. on the starters.



As explained in the illustration, the furnace consists essentially of the furnace chamber proper lined with firebrick and containing a small oil burner at the bottom, upon which rests the cast-iron pot filled with molten lead, and a flue system consisting of eight 4-in. pipes insulated with asbestos packing; the turning mechanism composed of a steel shaft fitted with three drill steel retainers; a short pipe cover, thrust bearing, gear and pinion, and a small speed-reducer unit mounted upon an elevated platform made from channels, plate, and angles; a steel ladder; and a fume hood. Speed of the central shaft is one revolution every 2½ minutes.

Total cost of operation, exclusive of fuel oil, is about $57.50 per month. Petroleum coke is used in a thin layer over the molten lead to prevent volatilization, and consumption is approximately one ton every two months when operating on a one-shift basis. Cost of the coke is $13.50 per ton plus freight from Los Angeles, Calif. The life of the cast-iron pot holding the lead is three months under one-shift operation, and its cost $60. Lead consumption per month is 250 lb.

Since the installation of this equipment, drilling costs have been lowered materially at the mine, and the machine men have ceased to complain about improperly tempered steel.

Drilling the Round

• II •

When Raising and Sinking

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IN DRIVING RAISES the same cut holes should be drilled as shown in the rounds already described. Care must be used in putting up the drill staging to get it at the proper distance from the back. Everything should be secured carefully, as this practice is one of the most hazardous of underground operations. The methods illustrated are safe.

The back should always be trimmed down until the driller is certain that it is safe, and the cut holes should be placed in such a position that the flying rock from the blast will do the least damage to the manway. In many mines, moreover, raises are driven without any manways and the muck from the last round is drawn before a driller can go back in to drill the next one. Under such conditions any broken stulls and staging must be replaced before the back can be reached and trimmed. Loose slabs or rocks are likely to fall and cause injury or death while this is being done. The practice is bad and should be prohibited.

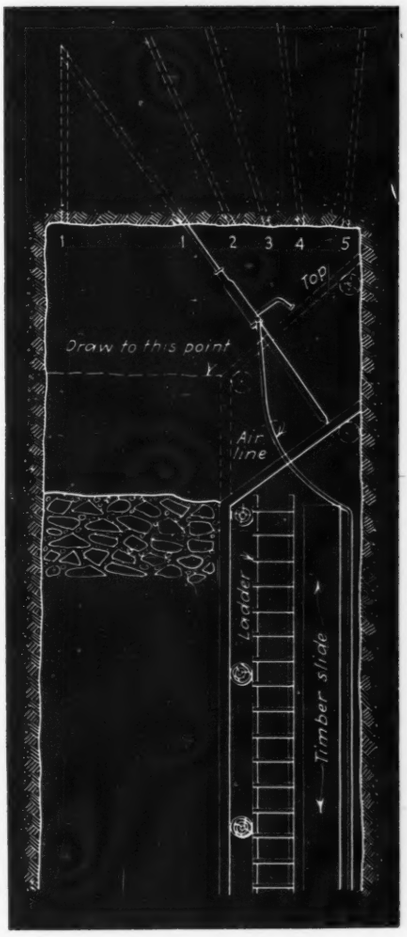
One method of driving raises is illustrated in Fig. 14. Stulls and lagging are used, and the manway and timber chute are carried on one side and the dirtway is carried on the other. This method is safe and economical, but not so good as cribbing. However, many mines do not have facilities for framing cribbing economically.

If a drifter mounted on a column is used instead of a stoping machine, this method is applicable. One should note that the cut holes are so placed that flying rock from holes 1 and 2 strike on broken rock. Holes 2, 3, 4, and 5 break against the wall and drop down. If this is done timber will seldom be broken.

After the round has been drilled and the machine and tools have been taken out, stulls and lagging should be placed, as indicated by the dotted lines, before blasting. Round lagging is recommended for the top lagging, inasmuch as it does not break so easily. Lagging should be put in on a slope of 40 deg. or more, so that the muck will roll off when the raise is drawn down to the point indicated by the dotted line. All that is necessary then is to knock off the two top lagging and trim the back until it is safe before drilling the next round.

Ventilation always being poor in raises, occasions arise when gas hangs in them to such an extent that it is impossible to work each day, with the result that rounds are lost. When such conditions are encountered the round shown in Fig. 15 can be used. Even though it is drilled every other day the footage will be practically the same. The cut used is known as the "burn cut," or Cornish cut. In recent years this cut has been used to good advantage in the Homestake mine, in Lead, S. D., and it offers a practical solution for several problems.

Fig. 14 . . . RAISING BY THIS METHOD involves the use of stulls and lagging, the manway and timber chute being carried on one side and the dirtway on the other



In such places where a new drift, crosscut, or raise is to be started there are usually timbers, pipe, track, and other things near the face. If the ordinary V-cut or pyramid cut be used, such things are sure to be badly damaged by the first few rounds blasted. The "burn cut" has the advantage that it can be used to start a new opening without damaging surrounding objects. With it very little rock is thrown out, and that only directly in the line of the cut holes.

When used in driving raises, the V-cut or the pyramid cut is likely to knock out the timbers, ladders, pipes, and the like when the round is blasted. With other types of round the size of the opening has a bearing on the depth of the round that can be broken. In the "burn cut" this is limited only by the toughness of the rock and the depth of the round that can be drilled in a shift. However, it is recommended that this round be used only in starting off new crosscuts and other openings, where surrounding objects are likely to be damaged by the flying rock from the ordinary blasts.

Detailed plans of this round are given in Fig. 15. It is necessary to follow the instructions carefully. Varitions can be made in spacing the holes and loading the round, to suit differences in rocks. Cut holes must be drilled straight in at right angles to the face and parallel to each other with a uniform distance between adjacent holes. The distance between the holes depends on the hardness and toughness of the rock. About 23 holes to the round are required in this type of cut in an 7x7-ft. raise or drift in moderately hard rock. In very hard rock more holes may be needed.

Holes shown with a circle around them in Fig. 15 are not loaded at all except in the very hardest of ground. Hole 1 is loaded full of dynamite and shot first, the cartridges not being split or tamped except in raises, where the last two cartridges should be split and tamped so as to hold the charge in the hole. If this hole breaks clear to the back and makes sufficient openings, holes marked "X" need not

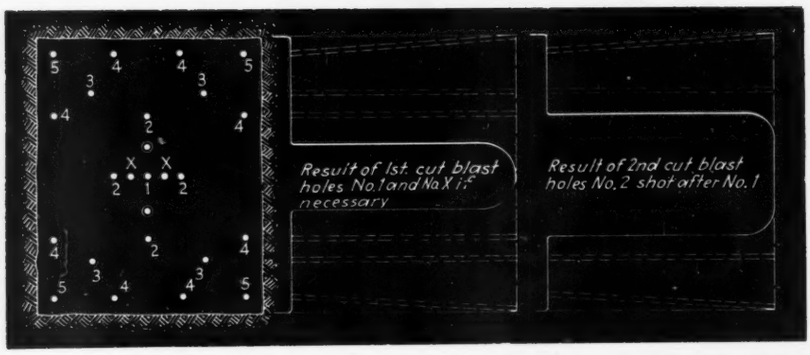
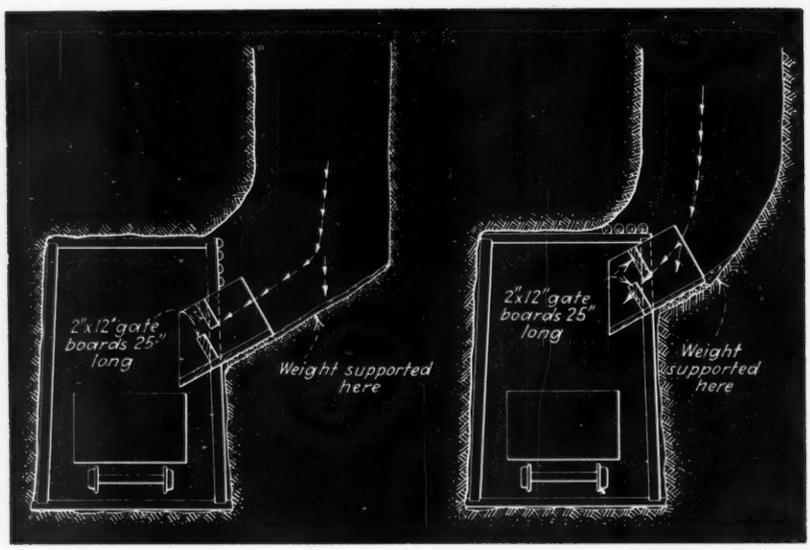


Fig. 15 . . . THE BURN OR CORNISH CUT, here illustrated, offers a practical solution for several problems, as explained in the text. By its use, the production of flying rock that may damage near-by equipment or timber is avoided



Figs. 16 and 17 . . . THE RIGHT AND WRONG WAYS respectively for starting a raise. When done as shown at the left the chute is protected from the falling muck. Otherwise it is subject to battering. Muck may be drawn and chute door closed with ease, which is not the case in the wrong way, shown at the right

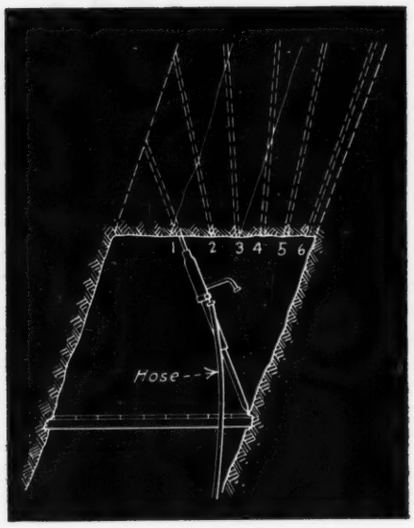


Fig. 18 . . . A RAISE ROUND for use where seams in the formation may be turned to advantage, by decreasing the amount of drilling required

be loaded. If a sufficient opening is not made, then the holes marked "X" should be loaded with four to six sticks of powder in the bottom of each and shot next. In drift rounds, after shooting Hole 1, it is sometimes necessary to clean out the hole with a scraper, as the rock that is broken may not all be thrown out by the blast, and it is important that a clean hole be left in the space around Hole 1 before the holes marked "2" are shot. Holes 2 are next fired, and it is necessary to return again to make sure that they have broken clear to the back. In a drift holes 3, 4, and 5 are then shot in the order named, with holes 6 and 7 following in their order. In raises, holes marked "3" are shot and then holes 4, 5, 6, and 7, in the order named. One variation in this round is to load hole 2 by slitting and tamping alternate cartridges, the first being loaded loose in the hole and the second slit on one side and packed lightly, the third loose, and so on. In trying this type of round one must usually make a few experiments to determine the proper distance between cut holes and the total number of holes necessary to break satisfactorily in different kinds of rock. It is practically impossible to give definite spacing of holes and correct charges of explosives to cover all conditions.

Fig. 16 and 17 show the proper and the improper way in which to drive a raise through which muck is to be drawn. One should begin at the desired height at the side of the drift, break the opening on about 43 deg. incline, and maintain this angle until the opening is far enough in to allow the entire discharge of the raise to be received on solid rock. When this is done, the raise can be continued in the desired direction. When a raise is so driven, muck or ore can be dumped into it when empty without serious damage to either timber or chute. The muck, moreover, can be drawn or shut off without great difficulty, owing to the fact that its weight is carried on the rock and not on the chute door, as it would be if the raise were driven as done in Fig. 17.

When the muck hangs up in a raise, it can be blasted without much danger of breaking timber or knocking out the chute if the raise has been started properly. The method described applies, of course, to raises that are to be used for ore and waste. Ventilating raises and manways can be driven in any way desired.

In drilling shafts, regardless of what cut holes are used to break the ground, conditions are encountered that are found in no other line of drilling. First, there is the water to contend with, which is often a serious problem. Sumps have to be made sufficiently large to provide for the suction of the pump so that the pump can be regulated to take care of the water. This sump should be cut low enough to drain all the water off of the rest of the bottom.

Care must be taken not to foul holes after they are drilled. This can be done by providing wooden stakes, 12 or 14 in. long, trimmed on one end to fit a hole snugly, which are inserted as soon as the hole is drilled and blown out. Blowpipes should be provided on separate hose, so that the machine hose does not have to be taken off each time the holes are blown out.

In many drilling operations the rock is so badly shattered that it is difficult to collar a hole, for as soon as the steel is pulled out the hole immediately fills up. To meet this condition pieces of pipe should be provided large enough to slip over the bit of the steel and long enough to reach through the shattered zone. A length is slipped over the steel and driven down as the hole is being drilled, until the pipe is against solid rock.

Too much care cannot be taken in loading shaft rounds, as a missed hole is very dangerous because of the difficulty and hazard of locating it. It is the cause of many missed rounds. Where extra precaution is desirable, each hole can be double-primed.

A shaft round is shown in Fig. 19. The depth of the No. 2 holes of the V-cut

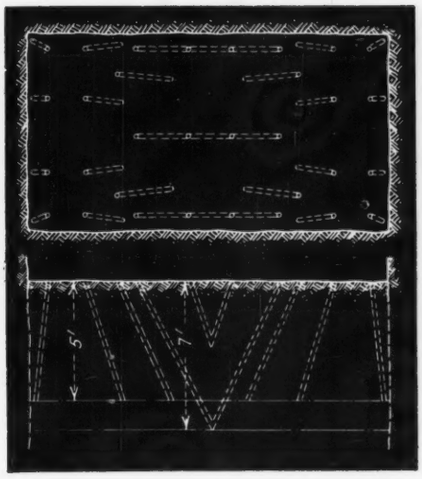


Fig. 19 . . . A 32-HOLE SHAFT ROUND, using a V-cut. The deeper cut holes serve to provide a low place in the bottom after the round is shot, where the water can collect while the following round is being drilled. See Fig. 20

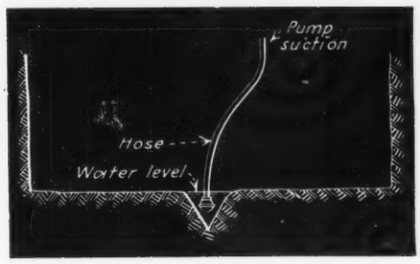


Fig. 20 . . . PROVISION FOR THE PUMP SUCTION can be made, as shown here, in shaft sinking. A V-cut, such as that illustrated in Fig. 19, can be used, or, if preferred, a diamond or a pyramid cut

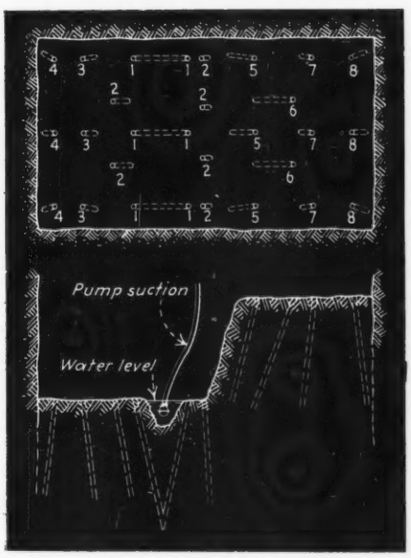


Fig. 21 . . . A 28-HOLE BENCH ROUND for shaft sinking. Here again the V-cut is employed. The round can be used except where timbering is carried close to the bottom

should be noted. It is at least 2 ft. more than that of the rest of the round. This provides a sump to take care of the water while the next round is being drilled.

The advantages of using this method are demonstrated in Fig. 20. In ground that a V-cut will not pull, a diamond or a pyramid cut can be used instead. The rest of the holes must be spaced as needed, there being no set rule for this.

The bench round illustrated in Fig. 21 has been found to give good results, inasmuch as half of the shaft bottom is slabbed off and is free from water at all times. It cannot be used in some shafts where the timbering must be carried close to the face. Under such conditions, however, drilling is no problem, timbering and mucking being the issue.

(*To be continued*)

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X-Ray Analysis of Mine Dusts

AT A RECENT MEETING of the Canadian Institute of Mining and Metallurgy in Ottawa, T. L. Walker, director of the Royal Ontario Museum of Mineralogy, described an X-ray diffraction method for the quantitative analysis of mine dusts, developed by Prof. George L. Clark, University of Illinois. Professor Clark has published a description of the method and results obtained (Analytical Edition, *Ind. & Eng. Chem.*, Jan. 15, 1936).

The method depends on the scientific fact that crystalline chemical compounds, when pulverized and placed in a monochromatic beam of X-rays, yield "diffraction patterns" unique for each compound, which may be registered photographically. Thus, quartz gives rise to a diffraction pattern peculiar to itself and always identifiable as such. In a mixture of crystalline minerals, each will give its own pattern regardless of the presence of other constituents. The photographic record of the pattern is made in a circular reflection-type camera, with the mineral sample at the geometric center and the film around the outer circular surface. The diffraction pattern will appear on the film as a series of characteristic lines of varying intensity, like the lines of a spectrum.

Natural ores and mine dusts subjected to analysis must be finely ground. Professor Clark found it necessary to grind 200-mesh quartz, for example, for 24 hours in a small steel ball mill loaded with ball bearings. With 200-mesh particles it was impossible to get smooth, continuous diffraction lines.

For the determination of silica in mine dust, standard series of samples are prepared from quartz and calcite, with the quartz content varying from 0 to 100 per cent. The range is divided into three sections: 0 to 10, 10 to 60, and 60 to 100 per cent. To 2 grams of the samples, thus prepared, 0.5 gram of fluorite is added to the first two sections, and 1 gram to the third, as an internal reference standard. Diffraction patterns are then obtained from these standard samples.

In the examination of a dust of unknown composition, a pure crystalline powder known *not* to be present in the mixture is added in a definite ratio, and the X-ray diffraction pattern is registered. The ratio of the density of a line of the substance sought to that of a near-by line of the added standard is determined photometrically. The ratio thus obtained is proportional to the line intensity of the substance sought, which in turn is proportional to the amount of the substance in the mixture. By reference to a curve which is prepared empirically, using standard mixtures of known composition, the percentage of the constituent sought is obtainable at once.

The smallest amount of quartz that can be identified positively by this technic is about 1 per cent, and the least amount that can be measured accurately is about 4 per cent. The method is not to be recommended for traces. Results can be duplicated within 5 per cent of the amount of the substance sought in the case of quartz. Aside from the long grinding time for the preparation of samples, analysis may be completed in about four hours.

•

Sulphur Dioxide Recovery From Metallurgical Gases

THE "sulphidine" process for the recovery of sulphur dioxide from waste gases from metallurgical furnaces depends on the use of xylidine as a solvent. It was developed, according to *Metallges. Periodic Rev.*, No. 11, 1935, by the Gesellschaft für Chemische Industrie in Basel and the Metallgesellschaft, A.-G., of Frankfurt. It is said to be particularly applicable to waste gases of low SO_2 concentration. Gas previously freed from dust, sulphur, and sulphur trioxide is washed in a scrubber with a 1 to 1 mixture of xylidine and water. Absorption is conducted at 15 deg. to 30 deg. C. Sodium carbonate is added to convert any xylidine sulphate to sodium sulphate, and the enriched liquor is heated to 80 deg. to 100 deg. C. to drive off the sulphur dioxide. Recovery is above 98 per cent and the gas is better than 99 per cent pure. Before the gas is compressed it is washed with sulphuric acid and dried. The xylidine solvent is recovered. At a refinery in Hamburg waste gases from copper matte converters, containing 0.5 to 8.0 per cent sulphur dioxide, averaging 3.6 per cent, are successfully treated for the recovery of pure gas.

The Metalliferous Altai Of Soviet Russia

• II •

Four of the polymetal mines are being worked today . . . Recent exploration has greatly increased the ore reserves

Andrew Meyer and Edith Meyer
Mining Engineer *Metallurgical Engineer*

THE GREGOROVSKY SHAFT,

at Ridder. In front of the headframe is the coarse crushing house. In the foreground a group of workmen is loading cars from the ore dump with a scraper

OF THE 70 to 75 polymetal mines which have existed in the Altai at one time or another, only four are operating at present. The others are either in the process of being explored by geologists or in a state of conservation. The strictly gold, tin, tungsten, and molybdenum mines are outside the scope of this article.

As has been already stated, exploitation of the mines of the Altai began in the middle of the eighteenth century on the site of the ancient Chud workings. In almost every case, very recent exploration has shown much greater deposits than were known to the Czar's Cabinet or to the Concessionaires. In this manner, diamond drilling has increased the ore reserves of Ridder and Belousovsk more than tenfold, and as yet the end of the ore is not in sight. Table I shows the production of the principal Altai mines from the time of their discovery up to 1910.

Mines listed in Table I produced 80 per cent of all the ore mined in the Altai up to 1910. The remaining 20 per cent of the total production was scattered among some 65 other smaller mines which are not producing today and about which little is known. The figures herein quoted for metal produced were taken from the Cabinet's records (along with the other figures), but are undoubtedly lower than actual, inasmuch as many tons of metal were admittedly neither given nor reported to the Cabinet.

From 1910 to 1927, mining operations were negligible so far as any production was concerned. However, beginning with 1927 the Ridder, Sokolny, and Zyrianovsk mines were started, with considerable difficulties. Their combined production is shown in Table II.

The Zmeinogorsk Group—This group is about 90 km. east of Rubtzovka, a station on the Turkestan-Siberian Railroad. It comprises ten ore deposits besides the Zmeinogorsk mine proper, which produced 1,750 tons of silver up to 1910 but which is now in a state of conservation.

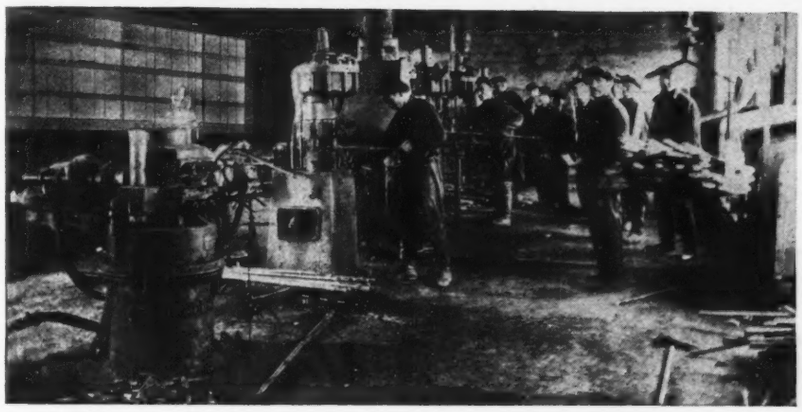
The ore deposits occur in a strip of Middle Devonian and Cambro-Silurian rocks squeezed in between two great granitic intrusions stretching to the northwest. The sedimentaries are broken by several faults and are intruded by quartz porphyries. In this occurrence the deposits are genetically connected with intrusive quartz keratophyres, and several diabase dikes intersect them.

At the Zmeinogorsk mine there are two separate ore deposits known as the "Great" and the Kaminsk. They extend on the surface northwesterly for 280 and 75 m. respectively, dipping northeast from 40 to 60 deg., and have a thickness of 30 to 50 m. The mine has been worked to a depth of 220 m. According to estimates, dumps lying near the mine hold 234,600 tons of ore containing 48,400 kg. of silver and 1,222 kg. of gold. Other dumps hold 280,000 tons of barite. Records show the existence of 211,300 tons of blocked-out ore in the mine, containing 48,450 kg. of silver and probably 1,250 kg. of gold. The possible ore reserve, in addition to these figures, is roughly estimated at 2,500,000 tons, averaging 50 grams silver and 1.5 grams gold per ton, 1.5 per cent Pb, 0.3 per cent Cu, and 2 per cent Zn.

Belousovsk Mine—This mine is located 18 km. north-northwest from the town of Ust-Kamenogorsk. It was worked from 1800 to 1887, and produced 6,060 tons of copper. It was closed when water became too much for the then existing pumps. During the last ten years intensive exploration has been carried on, and at present the mine is under development.

The deposit is in the southwestern Altai zone of folding, and the area is made up of igneous, sedimentary, and tuffaceous rocks deeply altered by regional and metasomatic metamorphism. The metamorphosed sedimentary rocks are calcareous chlorite schists, derived from marly and argillaceous shales; phyllitic, carbonaceous clayey slates; argillaceous and sandy slates; and marmorized, dolomitized, and silicified sandstones. Albitophyres were altered to porphyroids and to schists varying from slightly schistose to quartz-sericite schists. The rocks strike northwest and dip 40 to 50 deg. southwest. Near the veins they are strongly sericitised and impregnated with pyrite.

A number of more or less parallel lenses of repeated occurrence along the strike and conforming to the dip of the enclosing rocks constitute the ore deposit. The thickness of the lenses varies from 0.5 to 15 m. and that of the intervening sheets of barren rock from 0.3 to 3 m. The known ore extends along the strike about 2,200 m., but pinches

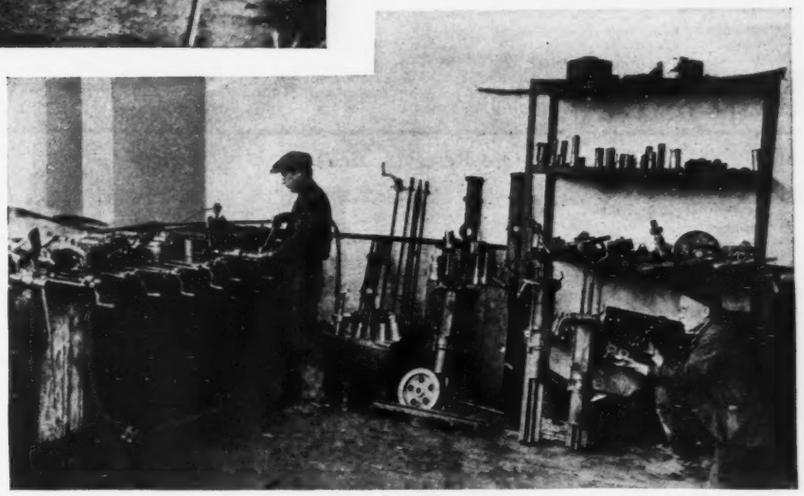


IN THE DRILL-SHARPENING SHOP

at Ridder. Here, with oil-fired furnaces, a man is said to sharpen 300 bits and more per six-hour shift. The equipment used includes that of various manufacturers

REPAIRING ROCK DRILLS

at Ridder. Most of the spare parts used here are made in the mine machine shop. Rock drills also are now being manufactured in the Soviet Union



AT ZYRIANOVSK

The headframe seen — that of the North shaft — is the only one built of steel in the district. Besides this there are three other shafts

out at a depth of from 150 to 250 m.

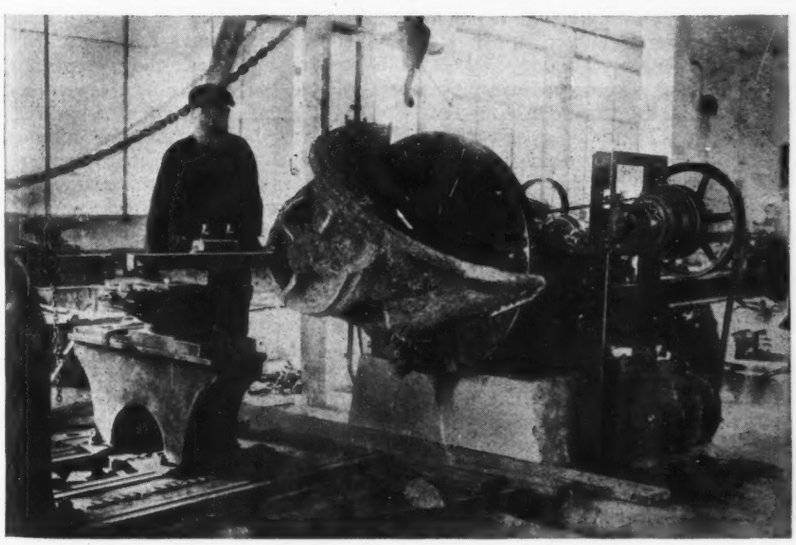
The hanging wall is composed of an intermittent series of sericitic quartz schists, talc schists, and phyllitic argillites. Besides these, interbeds of carbonaceous clayey slates and a number of albitophyre sills occur. The rocks alternating with the mineralized portions are similar schists so impregnated by the ore solutions that they grade into the orebody. The footwall consists of phyllitic carbonaceous and clayey schists intruded by albitophyre sills.

In May, 1934, the ore reserves given in Table IV were known.

The precious metal content is about 1.5 grams of gold and 30 grams of silver per ton.

Considerable difficulties in mining are offered by the complex nature of the ore deposit. The writer has recommended horizontal cut-and-fill as the most applicable method under the conditions, for this method permits the use of the intermittent barren rock to be used as filling. The property has two working shafts and a ventilating shaft. All of these are vertical. Underground is a dynamite magazine so designed as to minimize the effect of a possible explosion. Inflow of water into the mine is as yet almost negligible.

The compressed-air plant consists of one 15-cu.m. and two 40-cu.m. two-stage, direct-connected Robey Lincoln compressors. The rock-drilling equipment is made up of Chicago-Pneumatic No. 10 sinkers and Chicago-Pneumatic No. 5 drifters. Steel is sharpened on two Holman sharpeners. Electric power is received from the coal-burning power plant in Glubokaya, 18 km. away on the bank of the Irtysh River. By means of navigation on the river the mine can be reached; also by the newly



PART OF THE MACHINE SHOP AT RIDDER

In the chuck can be seen a half section of a slag pot which is being turned down after being cast. As can also be seen, whiskers have not wholly passed out in the U.S.S.R.

Table I—Production of the Principal Altai Mines Up to 1910

(Metric Tons)

Name of Mine	Ore	Silver	Gold	Copper	Lead
Zmeinogorsk	1,950,000	1.750	0.3	2	165
Zyrianovsk	842,000	865	1.5	80	81,000
Ridder	188,000	46	0.8	.....	30,000
Sokolny	215,000	106	...	.....	.....
Belousovsk	95,000	....	...	6,060	...
Talovsk	125,600	....	...	11,690	17
Chudak	19,500	....	...	2,380	.....
Petrovsk	395,000	203	...	...	...
Nikolaevsk	180,000	70	...	21	787

Table II—Combined Ore Output of the Ridder, Sokolny, and Zyrianovsk Mines, 1927 to 1932 Inclusive

(Metric Tons)

1927–28....	20,998	1930 (last 3-4 months) ..	38,653
1928–29....	50,367	1931....	173,619
1929–30....	92,843	1932....	168,485

Table III—Actual and Planned Ore Production of Altai Mines

(Metric Tons)

Mine	1933	1934	1935	1936	1937
Ridder group[1]	160,728	206,217	320,000	500,000	500,000
Zyrianovsk	27,006	40,000	55,000	70,000	80,000
Belousovsk[2]	.....	.....	.....	150,000	360,000
Berezovsk	.....	.....	.....	.....	30,000

[1]The Ridder group consists of the Ridder and the Sokolny mines.
[2]The authors estimate that at the present stage of development of the Belousovsk mine possible production for 1936 will be 15,000 tons of ore.

Table IV—Ore Reserves, Belousovsk Mine, 1934

(Metric Tons)

Tonnage	Average Assay, Per Cent Cu	Pb	Zn
Proven, 5,000,000	3.36	1.66	7.57
Probable, 1,500,000	3.20	1.97	11.00
Possible, 4,000,000	2.00	1.50	8.00

Table V—Ore Reserves of the Zyrianovsk Mine as of March, 1935

Ore	Category	Ore Reserves (Metric Tons)	Average Assay: Gold (Grams/Ton)	Silver (Grams/Ton)	Copper %	Lead %	Zinc %
Sulphide	Positive	389,000	9.5	470	2.7	11.7	22.6
	Probable	170,000					
Impregnated	Probable	1,866,000	0.8	27	0.4	1.5	3.3

Table VI—The Ridder Ore Reserves, Tonnage and Grade

Kind of Ore	Metric Tons	Metallic Content: Silver (Grams/Ton)	Copper %	Lead %	Zinc %	Iron %
Sulphide	1,246,069	248	1.32	15.18	28.81	7.46
Impregnated	5,178,940	25.4	0.38	2.49	5.05	6.08
Mineralized slates	217,119	60.6	0.19	1.83	4.54	4.25
Zinc carbonates from hanging wall	1,240,000	...	...	....	4.00	...
Impregnated ore from footwall	327,016	64	0.57	4.87	9.73	9.1
Oxidized ore left in pillars	372,056	54	1.04	5.91	1.12	....

completed Rubtzovska-Ust-Kamenogorsk Railroad.

Zyrianovsk Mine—This mine is the largest in the group bearing its name. See Fig. 2. None of the other deposits of the group is now producing, though an exploring party is working on the Grekhovsk deposit. Zyrianovsk mine, like the others in the Altai, was formerly worked for silver and gold, mainly in the oxidized zone.

The orebody outcrops on the southern slope of what is known as Ore Hill, among intensely folded slatey tuffs interwoven with other tuffs, argillaceous slates, effusive porphyries, strongly metamorphosed sericitic chloritic slates, micaceous quartzites, and porphyroids. The deposit is genetically connected with quartz porphyries. In this occurrence the wall rocks are composed of chlorite and sericite slates, calcareous-biotitic slates, and the typical highly siliceous hornstone. Diabase dikes also occur, intensely altered by metamorphosis accompanying the ore deposition.

The deposit has the form of an anticline, the top of which was removed by erosion, the rest now being mostly covered by alluvia. It is divided into two distinct orebodies, the Southern and the Northern, which in their western extremities are almost joined together in the upper levels. Of the two, the Northern orebody is better known, for it is opened up to a length of 600 m. and to a depth of 234 m. The orebodies strike east and west and dip toward each other at about 75 deg. Their thickness varies from 6 to 35 m., out of which usually 1 to 12 m. is rich sulphide ore, the rest being impregnated ore. Sometimes the latter is separated from the sulphides by 1 to 10 m. of highly metamorphosed but almost barren wall rock. This is especially true in the Northern orebody, where the impregnated zone is almost always on the footwall side. See Fig. 4. Gangue minerals are quartz and barite, with some sericite, chlorite, and biotite. With depth the barite becomes less and its place is taken by calcite and ankerite. The oxidized zone is about 90 m. deep, but the zone of secondary enrichment is only a few meters below surface. The oxidized zone is composed of oxidized minerals of copper, lead, iron, and zinc. Small amounts of cerargyrite and nuggets of gold, silver, and electrum are found. The average metallic content of the oxidized zone is: 1,200 grams of silver per ton, 12.8 per cent lead, 4 per cent copper, and 5.9 per cent zinc.

What the extent is of the Zyrianovsk orebody is far from being known. Much underground exploration and diamond drilling must still be done before total reserves can be estimated.

Mining and Equipment — The orebodies can be reached through four shafts, the North Shaft being the deepest. Formerly the square-set method had been used to remove ore, but in view of the relatively strong wall rocks and the convenient dip, the writer introduced successfully the inclined cut-and-fill method for the narrower and stronger sulphide veins and the Gilman cut-and-fill method for the wider and weaker impregnated orebody. Daily production is 275 tons of ore, which could easily be increased to 350 tons.

Inflow of water is about 100 cu.m. per hour from both orebodies. The sump and pump chamber are on the 18th level. The mine is drained by two 4-in. Plurovane pumps, manufactured by Mather Platt, Ltd. One of these is always in reserve.

The compressor plant contains a Robey-Lincoln, 40-cu.m., two-stage direct-connected compressor, a Westphalia 36-cu.m., two-stage direct-connected machine, and a Boretz (Soviet) 22-cu.m., single-stage, belt-driven compressor.

For drilling Chicago-Pneumatic No. 10 sinkers and Chicago-Pneumatic No. 146 stopers are used, the sharpening being done on a Holman machine. Power is supplied by a coal-burning power plant located on the mining property, and a hydro-electric plant on the Turgusun River 35 km. away.

A 70-km. graded dirt road connects Zyrianovsk with the Irtysh River, by means of which the mine is kept in supplies during the summer. In winter transportation is limited to horse-drawn sleighs.

The Ridder Group—This group, the most important producer today of lead and zinc not only in the Altai but in the entire Soviet Union, is situated at the foot of the Ivanov Range near the source of the Ulba River. A number of very incompletely explored poly-

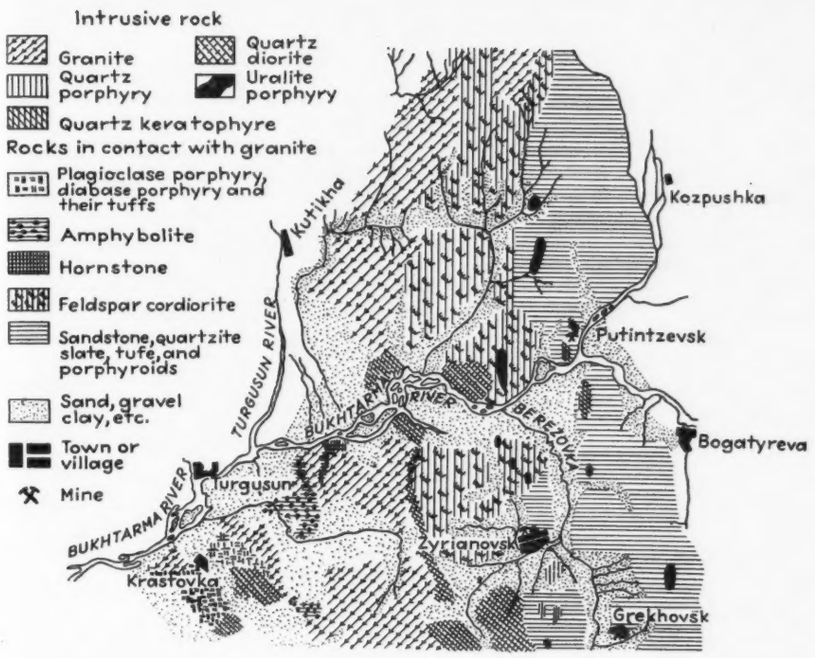


Fig. 1 . . . RUSSIAN GEOLOGIC CONVENTIONS

describe the legend which indicates the intrusive and sedimentary rocks which are found in the Zyrianovsk mining district of the Altai Mountains. The scale is approximately 1:210,000

metal deposits are found, of which only the Ridder and Sokolny mines are producing ore today. About 70 per cent of all the known reserves of zinc in the Altai is at Ridder, and this corresponds to 30 per cent of the zinc reserves of the entire Soviet Union. For lead reserves 80 per cent and 35 per cent are the corresponding figures.

In the Ridder group the main deposit is in the upper part of Lower Devonian sedimentary rocks. These occupy an area of 35 sq.km., dipping south of southwest. On the northeast and east the metamorphosed series passes under the Devonian, stretching northwest with a sharp dip to the northeast. They consist of epidote-chlorite, quartz slates, porphyroids, and plyllitic slates, and are of Cambro-Silurian or Lower Devonian age. On the northwest, the Devonian is bordered by a granodiorite massive, which is cut by numerous quartz keratophyre and altered diabase dikes. In the Devonian series intrusions of quartz keratophyre and diabase sills occur.

The solid sulphide ore, deposited between the highly silicified (rogovik) footwall and the argillaceous slates of the hanging wall, is regarded locally as the critical horizon. See Fig. 3. Here the ascending mineral solutions found the last obstacle to their rise. The footwall was much more subjected to changes by replacement than the hanging wall. Tuffs were changed into flint-like hornstone (rogovik) and were impregnated with metallic sulphides and gold. The thickness of these hornstones often exceeds 100 m., but only their upper portions can be considered ore.

The ore deposits are on three anticlinal folds, which are complicated by smaller folds. Ore concentrations, especially solid sulphides, are found in the cupolas of the small anticlines, and are present in their flanks and troughs also. This clearly shows how the critical horizon for ore deposition depended on tectonical forms. Following ore depositions there were more tectonic movements, indicated by folding and faulting. There were three ore genetic phases:

1. Mineralizing solutions rising from quartz-keratophyre intrusions passed through the porous tuffs, silicifying them, and pushed the slate hanging wall upward.

2. The circulating hydrothermal waters charged with metallic solutions followed

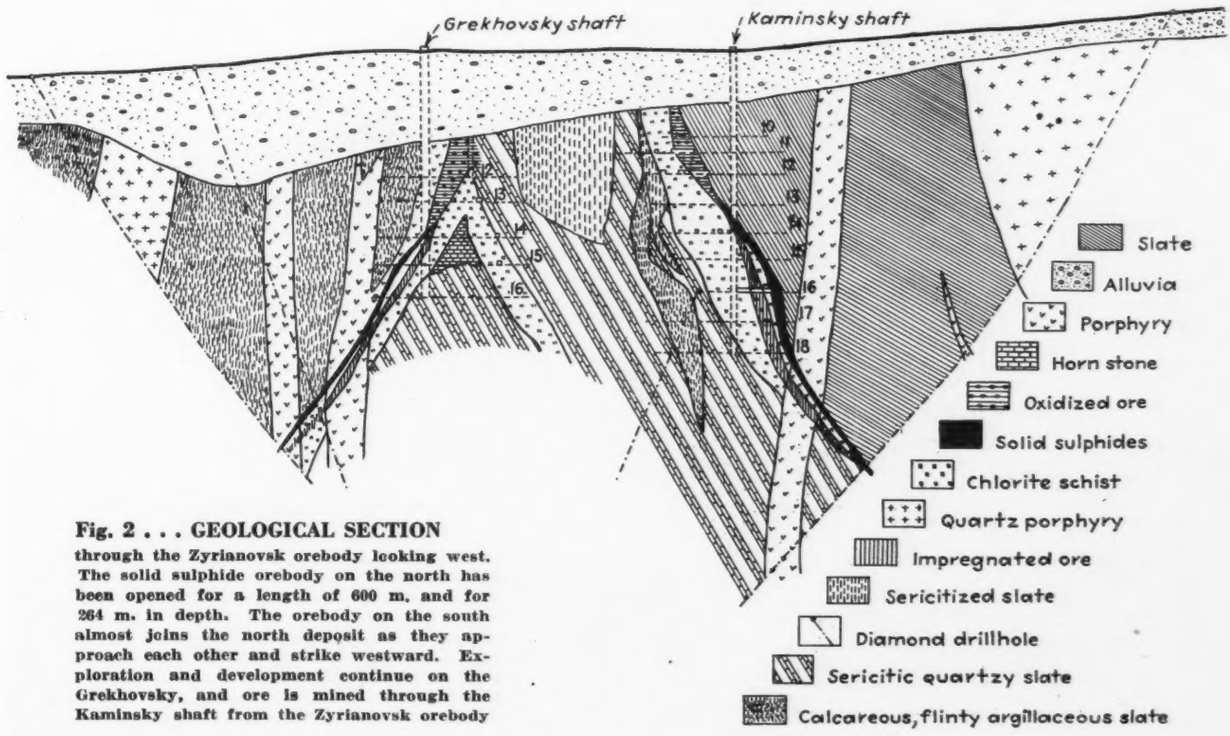


Fig. 2 . . . GEOLOGICAL SECTION

through the Zyrianovsk orebody looking west. The solid sulphide orebody on the north has been opened for a length of 600 m. and for 264 m. in depth. The orebody on the south almost joins the north deposit as they approach each other and strike westward. Exploration and development continue on the Grekhovsky, and ore is mined through the Kaminsky shaft from the Zyrianovsk orebody

the folds of the slate hanging at its contact with the tuff footwall and deposited their load of rich sulphide minerals. At the same time the silicified footwall was impregnated with sulphides and gold.

3. The third phase resulted in the deposition and appearance of carbonates, little chlorite, masses of sericite, quartz, barite, and pyrite, and a small amount of lead and sinc sulphides along weak contacts. With this phase is associated a greenish gray siliceous rock containing some sulphides and mottled with globules of carbonates, which is regarded as hydromagma and in Ridder occurs only in the footwall, whereas in the Sokolny mine it may occur in the hanging wall as well, and sometimes contains enough sulphide to be considered as ore.

As a result of post-mineral folding, both the Ridder and Sokolny orebodies are somewhat dome shaped and dip west. The dip of the Ridder deposit varies at different levels from 0 to 75 deg. The deposit is about 310 m. long, 140 in. wide, and with a depth of 175 m.

Sokolny's deposit is composed of seven lenses varying from 50 to 150 m. in length, 30 to 50 m. in width, and 7 to 35 m. in thickness. See Fig. 4.

The full size of the Ridder ore reserve is not known as yet. Diamond drilling regularly discloses new orebodies. In 1933 the known reserve was estimated at 8,581,200 tons. The composition is given in Table VI.

Also in 1933 the known ore reserves of the Sokolny mine were given as being 6,397,330 tons having an average metal content as follows: Silver, 98.5 grams per ton; copper, 0.8 per cent; lead, 4.6 per cent, and zinc, 6.5 per cent. The gold content may be taken as 10 to 15 grams per ton as an average for both the Ridder and Sokolny mines.

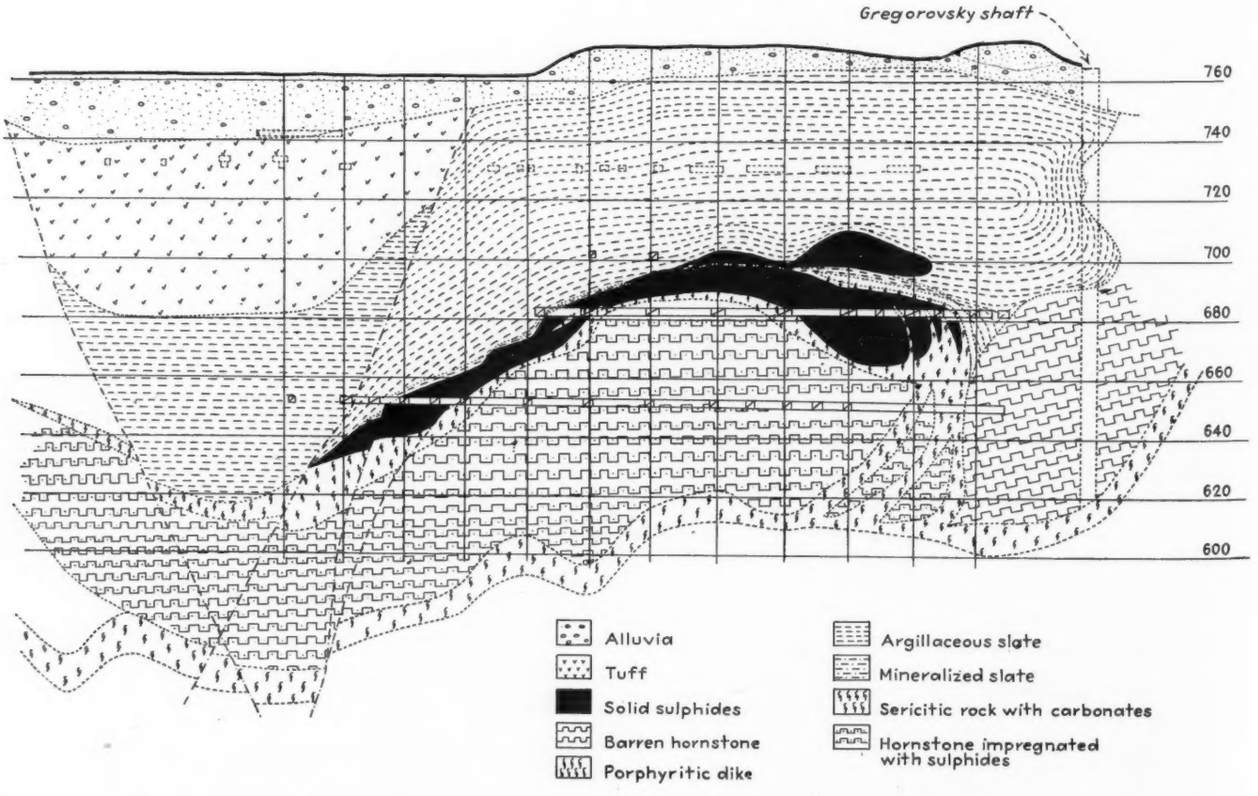
One should note that in 1933 the known ore reserves for both Ridder and Sokolny were 14,978,530 metric tons, having a distribution of metal as clearly given in Table VI, whereas, at the end of 1935, as a result of the many disclosures from diamond drilling, the combined ore reserves for Ridder and Sokolny were estimated at 31,633,530 metric tons, out of which about 5,000,000 tons is available for immediate exploitation.

In addition to the metals already mentioned, cadmium, antimony, and arsenic are present in small quantities. Every thin section of ore specimen shows tetrahedrite and calcopyrite under the microscope; about one in a hundred thin sections shows arsenopyrite. It is possible that another antimony mineral, tetanite, is also present. The average ore over a long period showed 0.05 per cent of cadmium, 0.05 per cent of antimony and 0.004 per cent of arsenic.

Mining and Equipment—The Ridder and Sokolny mines are operated under one management and are undoubtedly among the best operated mines in the Soviet Union. Ridder mine is worked through two openings, the five-compartment Gregorovsky and the four-compartment North shafts. The latter is used mostly as a service shaft.

Fig. 3 . . . RIDDER OREBODY

In section determined by underground workings and diamond drilling shows the anticlinal characteristics typical of most of the ore deposits in the Altai region. This mantotype deposit dips in varying degrees from 0 to 75 along a length of 310 m. Diamond drilling in progress several years has determined new orebodies which add greatly to the possibilities of unusually high ore reserves of zinc and lead. The Ridder group of mines is considered the greatest zinc and lead producer in the Soviet Union. Production is rising each year as transportation facilities improve and additional equipment is supplied



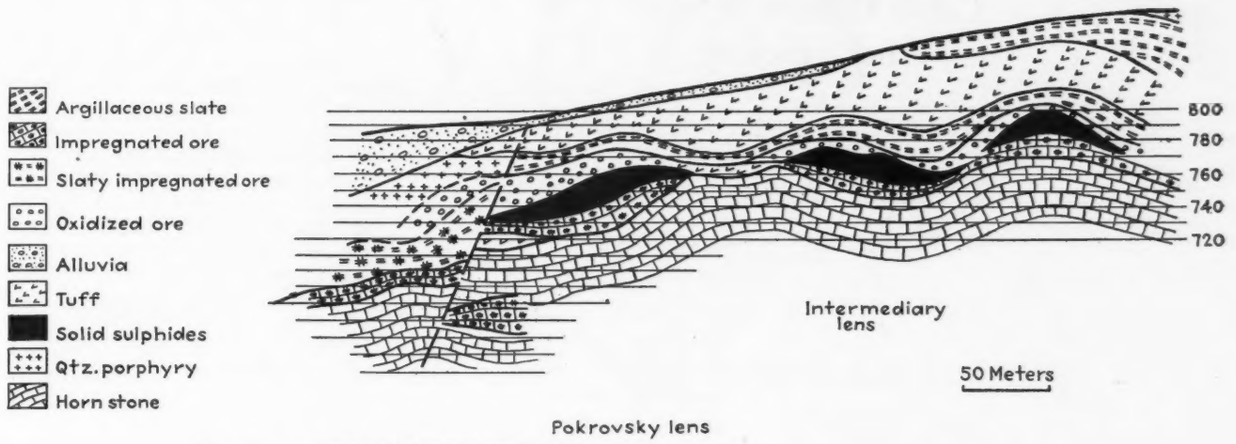


Fig. 4 . . . THE SOKOLNY DEPOSIT
consists of several lenses of sulphide zinc-lead ore all varying in length from 50 to 150 m. Widths vary from 30 to 50 m. and their thickness runs from 7 to 35 m. In some locations these deposits have been subject to post-mineral faulting resulting in a westerly dip

At present, horse tramming is used, but by the end of 1936 it is planned to introduce electric tramming.

Granby cars are to be drawn by battery locomotives. Ore is dumped into a 750-ton pocket on the ninth level, from which it is hoisted by skip and dumped into the bin at the Gregorovsky shaft. The drifts and crosscuts are electrically lighted, the drifts being driven through the orebody and around it in the footwalls and hanging walls, and connected with each other by crosscuts spaced 11 m. apart. Three-compartment raises are put up at intervals for lowering supplies, men and filling material. Chutes are placed from 4 to 6 m. apart. Outside arc chute gates are used.

The ore is mined in narrow blocks three sets wide, this being followed by close filling. Pillars equally wide are left between the stopes. The sill floor is not mined at this stage. After the stopes are filled up to the level pillar the pillars are mined to the same height, followed by careful and close filling. The third step is the removal of the floor pillar. All three operations may go on on the same level, but, of course, not in the same place.

The ground is very heavy and treacherous at the contact, especially on the hanging wall. The highly silicified zone of impregnated ore, on the other hand, is very tough and strong. For this section a method of mining similar to that of Homestake was recommended. In the writer's opinion an adaptation of the Gilman cut-and-fill would be safer and much cheaper than the present system.

Filling is obtained from a huge mass of tuff overlying the orebody. Shrinkage stopes, after the manner of Alaska Juneau, are prepared and blasted as filling is needed. In the last blast 10 tons of 30 per cent Ammonite was used, giving about 30,000 cu.m. of filling material.

There is a pump chamber and sump on the eighth level; also on the ninth. From the eighth level 6 cu.m. of water is pumped per minute, and from the ninth level 1.5 cu.m. per minute.

The air plant has five compressors. They are: Two Worthington, each 45-cu.m., two-stage, direct-connected; one Ingersoll-Rand, 32-cu.m., two-stage, direct-connected; one Eslinger, 45-cu.m., tandem, two-stage, direct-connected; and one Boretz, 20-cu.m., single-stage, belt-connected.

Rock drilling equipment includes sinkers, stopers, and drifters of Chicago Pneumatic, Ingersoll-Rand, and Nivyanovsk manufacture. The latter is a Soviet factory which has begun to manufacture rock drills similar to some of the American types. There are seven drill-sharpening machines of Climax, Ingersoll-Rand, and Holman make. Of these three machines are usually working, the others being either under repairs or in reserve. A man sharpens from 300 to 500 bits in a six-hour shift, and there are four shifts a day. Magnetic indicators are used for tempering bits. Broken drill steel is electrically butt-welded according to a method that has been worked out by the authors.

Sokolny mine is at present worked through an adit, and the ore is raised up to it from lower levels by an incline. Horse tramming is also used here, each horse drawing six three-quarter-ton cars. In this mine the ore occurs mostly as impregnated hornstone, a very strong and tough rock. Open stopes 8 m. wide, separated by pillars 5 m. thick, are used. The pillars are drilled while the stopes are being mined and are blasted later. Scrapers are used to slush the ore into chutes.

Timber for the Altai mines is brought in from the surrounding forests from a distance of 25 to 45 km. from the mines and costs about 75 rubles per cubic meter.

Cost of ore on the surface is 25 rubles per ton. Into this figure goes the cost of tramming at 1.20 rubles per ton and filling at 4.50 to 5.00 rubles. Power costs vary from 7 rubles in summer to about 20 rubles per ton of ore in winter. The latter figure is high due to the fact that during the past few years not enough coal was available and it was necessary to burn wood at the power plant for about three months. However, with the opening of the Ridder-Rubtzovska Railroad and the partial completion of the Ulba hydroelectric plant, both coal and electrical energy should be available in larger quantities and cheaper from 1936 on.

About 950 men are employed underground in both Ridder and Sokolny mines. On this number is based the productivity figure of 1.1 tons of ore per man. In the entire Mining Department 1,500 men are employed, of whom at all times about 100 are on the vacation list and 60 on the sick list. The structure of management is very similar to that of mines elsewhere, with a superintendent and two assistants in charge of exploitation and development, under whom are foremen and shift bosses with the common laborer working six hours a shift and every sixth day a rest day.

Labor in the Altai mining region consists of native Kazaks, who come to this work directly from a primitive nomad existence, and Russians from every part of the Soviet Union and of varying degrees of skill. It is the tendency to encourage after-work classes conducted for teaching technical as well as the simple rudiments of the work. Especial attention is given to the native Kazak labor, so that at present about 65 per cent of all employees are Kazak.

(To be continued)

Cable Guard Is Safe And Efficient

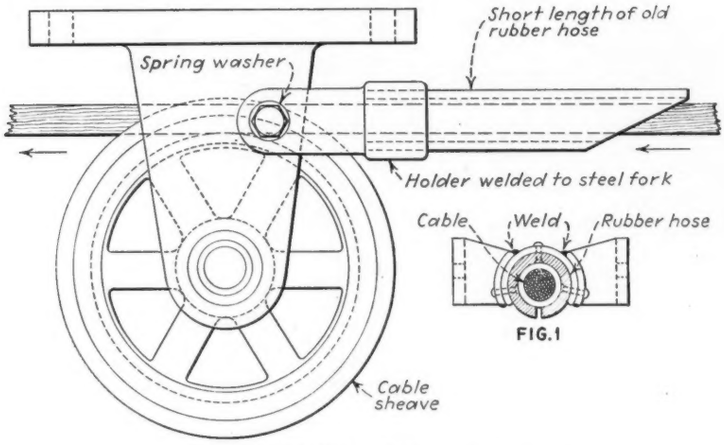


FIG. 1

CABLE GUARD is held in position on the sheave pedestal by screws. It is designed to prevent hands from being caught between cable and sheave

UNGUARDED CABLE SHEAVES on aërial tramways and other ore-conveying equipment are frequently responsible for injuries to the hands. Line or inspection men have the habit of holding on to the moving cable while walking along the catwalk and often forget to remove the hand from the cable as it approaches the guide sheave. Serious injury to the hand invariably results. Such accidents happened repeatedly at a lead-silver mine in central Spain, and as a consequence the management directed the safety department to find a means to overcome this hazard.

Pierre Lawrie, safety engineer, solved the problem satisfactorily by installing the simple and inexpensive cable covers shown in the accompanying sketch. Each unit consists of a steel fork with a welded-on semicircular holder, and a short length of split rubber hose as in Fig. 1. It is secured to the sheave pedestal by two short screws and spring washers. In addition to being safe, the device can be quickly removed for repairs to the sheave or to effect a change of cable.

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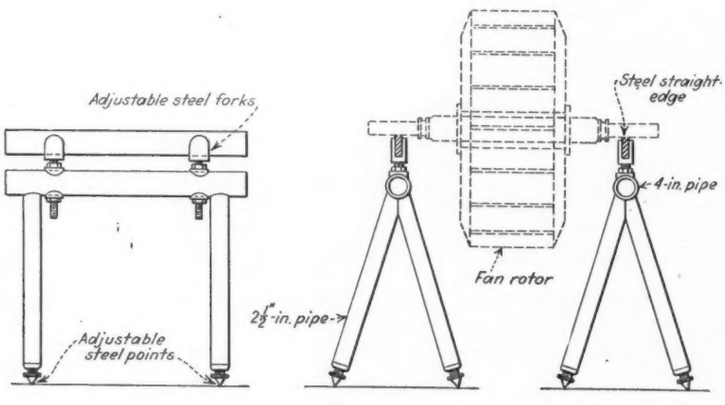
Balancing Fan Rotors

REWINDING of electrical motors and reblading of fan and turbine rotors are jobs that frequently have to be done in the shop of the average mine or smelter. Proper balancing of these rapid-moving parts is important if efficiency and long life of the repaired equipment are to be insured. When appropriate tools are lacking, the balancing of rotors is time-consuming and tedious work. Usually it is done on a large surface plate or on the platen of a planer fitted with two machined brackets to hold the machine part that is to be balanced. These tools, however, cannot always be taken out of operation and set aside for special or rush jobs without upsetting the shop schedule.

J. Kraetz, foreman at the Junction machine shop of the Phelps Dodge Corporation's Copper Queen Branch at Bisbee, Ariz., overcame this difficulty by employing the simple layout explained in the accompanying line cut. It consists of two welded steel stands or carpenter horses made from 4-in. and 2½-in. pipe, each fitted with four adjustable leg ends and two machined forks. These forks have a milled-in slot to accommodate the carefully machined straight-edges upon which is placed the rotor to be balanced. Leveling out of the straight-edges can be done by either turning the leg ends of the stands or by raising or lowering the threaded ends of the forks. The stands used were made entirely from scrap material.



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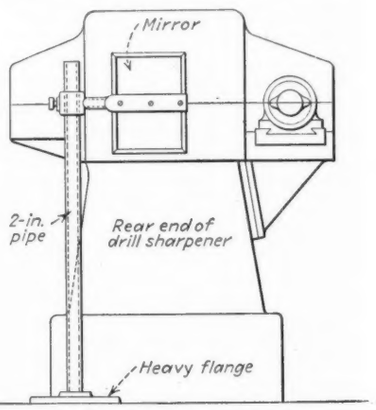
Mirror on Sharpener Provides Safety — Increases Output

PREVENTION OF INJURY to the eyes of men on drill sharpeners is the object of a device employing a mirror which has been developed at the Phelps Dodge shops at Lowell, Ariz., by William Hart, foreman. This device also increases the daily output of the sharpeners by permitting observation of the bit during forming and finishing, thereby obviating frequent stoppage for inspection and making it unnecessary for the operator to bend over to watch the work. Many a serious injury to the eye has resulted from flying scale while bending thus over the machine.



As the accompanying cut shows, the device consists of an inexpensive framed mirror attached to a portable stand made from scrap materials. The upright is a short length of 2-in. pipe, and the base a heavy flange. The crosspiece to which the mirror is screwed can be moved up and down and is held tight by a thumbscrew at any place desired. Results obtained at the Junction shop have been so favorable that the device has been adopted at all other Phelps Dodge repair shops.

NEWS
OF THE INDUSTRY

South Africa

Rand Gold Ore Production Increasing

● **SEVERAL MINES set new highs in May—Developments in Tanganyika encouraging**

London Correspondent

✦ There is nothing in the May operating results which indicates that the new tax law is changing the production policy of the Witwatersrand gold-mining companies. A dozen companies treated slightly higher-grade ore and a larger number ore slightly lower than in the preceding month. Mining sentiment has become much more optimistic, however, and prior to the recent decline in the price of gold the opinion prevailed that, as a result of the new tax law, dividend payments would be increased.

✦ From an analysis of the returns, the Witwatersrand companies crushed about 6 per cent more ore in May, 1936, than in May, 1935, and the average recovery per ton milled was 4.73 dwt., against 4.87 dwt., a decrease of only 0.14 dwt. This decrease is due in large part to increasing activities of the lower-grade mines, and therefore is negligible. There has been a general tendency to give it far too much emphasis. What is more important than the slight average decline in grade of ore milled is the fact that some eight or ten Witwatersrand companies set up new high records of tonnage crushed in May. Production of 1,000,000 oz. of gold a month is being predicted as an early accomplishment. This prediction is based on the prospect that all records of ore milled will continue to be broken as the year advances.

✦ At a recent meeting of Kentan Gold Areas, Ltd., Sir Robert Williams expressed the opinion that the area being opened up by the company in Tanganyika Territory by the Saragura Development Company (Sanza Concession) is likely to become one of the most important gold fields discovered in recent years. Geita Gold Mining Company has been organized to acquire a portion of the Saragura area. The new company will be about 98 per cent owned and controlled by Kentan Gold Areas, which will provide the funds to develop and equip its property. Kentan is issuing 500,000 additional 10s. shares at par, underwritten for this purpose. In the Geita property the management feels confident of developing 921,000 tons of 5.7 dwt. ore above the main haulage level, and of increasing this to 2,000,000 tons of 6 dwt. during the next year. These tonnages are calculated on the basis of a width of 114 in. for the orebody, and this is declared to be conservative. Other orebodies, also of exceptional width and good grade, have been explored to some extent in the Geita property, but their possibilities are not taken into consideration in arriving at the estimates of ore reserves.

✦ A rock-burst in the working shaft caused the output of Simmer and Jack to be considerably reduced in May. It is reported that the damage has now been repaired.

✦ In the Kakamega district Kimingini Gold Mining Company recently cut the reef by drilling at a vertical depth of 600 ft., the core showing 11.2 dwt. over a width of 2 ft. Estimates hitherto had given the gold deposits of Kakamega a depth of 500 ft.

✦ The gold production of Southern Rhodesia is continuing to increase. It came to 68,694 oz. in April, against 67,350 oz. in March. The value of the April gold output was £472,722, including premium, and of Southern Rhodesia's total mineral production, £590,849, this indicating the relative importance of gold.

✦ Rhodesia Minerals Concession's Chakwenga gold development in Northern Rhodesia continues interesting. Dr. J. A. Bancroft reports that two crosscuts on the 150-ft. level disclosed 3-ft. of ore averaging 21.7 dwt. in one case and 5.2 dwt. across 5 ft. respectively. A 70-ft. drive from the adit level gave an average of 22.11 dwt., or with high assays deducted the value amounted to 11.76 dwt., the average width being 9 ft. The erection of a power plant which will permit the deposit to be investigated below water level is being considered, surface enrichment being in evidence in the upper workings.

✦ Rhodesia Broken Hill Development Company produced 1,800 long tons of slab zinc, 115 tons of vanadium concentrates, and 14 tons of fused vanadium in May.

✦ The three Northern Rhodesia copper companies are limiting their outputs to their production curtailment quotas, but are fully prepared to expand when marketing conditions warrant. Mufulira Copper Mines has completed its smelter. It will nevertheless continue to ship its concentrates to the Roan Antelope smelter, probably till its output quota is increased.

✦ Tetiuhe Mining Corporation, Ltd., is to be liquidated, as it has sold its holdings of U.S.S.R. Government State notes to an exporting company. The State Notes were payable in driblets from October, 1939, to October, 1949, and as these were Tetiuhe's only asset (they were received for the sale of the company's property to the Soviet Government), a cash offer was accepted, this eliminating the expense of keeping the company in existence. The Tetiuhe Mines are in Siberia north of Vladivostok and are producers, principally, of lead and zinc.

Yugoslavia

✦ Trepca Mines was idle during the last half of May. Production for the month was 2,555 tons of 79.9 per cent lead concentrates averaging 25.5 oz. of silver per ton, and 3,432 tons of 50.47 per cent zinc concentrates. Operations were resumed June 3. Trepca has declared an interim dividend of 4½d., tax free, as against 3d. a year ago.

Utah

Silver King Coalition To Sink New Shaft

● MINES in Beaver County rehabilitated — Assessed valuation of mines increased

✦ It is estimated that eighteen months to two years' work will be required to sink the new triple-compartment shaft to a depth of 1,800 ft. to facilitate development in the northwestern part of the Silver King Coalition Mines Company property at Park City, Utah. This shaft will be sunk east of the old California-Comstock shaft. The company also plans to install a new 400-hp. electric hoist at the main shaft to replace the old steam hoist in service for 40 years.

✦ The Tintic Standard Mining Company will pay its regular quarterly dividend of 7½c. a share, totaling $86,498.63, on July 1, bringing the grand total of disbursements of the Eureka property up to $15,901,199.35.

✦ A dividend of 5c. per share will be paid by the Mammoth Mining Company on July 1, totaling $19,000. New developments on the lower levels have put the mine in a strong position. Earnings are understood to average about $15,000 monthly.

✦ Considerable new work has been started at Beaver County mines. Eastern capital is financing the reopening of the Quad Metals, known as the Old Carbonate property. The 750-ft. shaft is being retimbered and unwatered. Work is being resumed at the Honey Boy and Creole mines. The Beaver Gold & Copper Company plans resumption of operations in the inclined shaft, where from the 450 to the 550 level high-grade ore has been followed. On the 550, the mineralization is said to be 22 ft. wide. The company will now sink to the 650-ft. level to open this deposit in depth.

✦ Shipment of 40 tons of ore from the Little May Mining Company's property, Raft River, Box Elder County, is reported by the management. This shipment carried an ounce of gold to the ton and 2.5 per cent lead. A raise from the intermediate tunnel is developing high-grade gold ore.

✦ The Tintic Ophir Mines Company has started construction of a road from the main highway, in Ophir Canyon, to the principal workings on Lion Hill. Contract for the work was awarded to Harry L. Bracken. The company has also let a five-year contract for the haulage of ore.

✦ Reopening of the roads into the Little and Big Cottonwood mining district, 25 miles southeast of Salt Lake City, has resulted in a resumption of shipments and operations. The Cardiff Mine has shipped 400 tons of ore, said to average $30 a ton in gold, silver, and lead values, and has 800 more tons ready to ship. Sinking of the shaft has reached a point 165 ft. below the 1,400-ft. level. Crosscutting will be started soon to reach the downward intersection of the main Cardiff orebody. Development and mining of ore is also progressing on the 800, the 702, the 1,250 and the 1,400 levels.

✦ On the Alta side of the district, the State Road Commission, the WPA, and Salt Lake County are cooperating to spend $250,000 on improvement of the Little Cottonwood highway. This will be a boon not only to operators but to tourists who wish to visit this scenic area.

✦ At Alta, the Alta United Mines Company is planning to drive two drifts from the Dwyer tunnel, one to prospect the Jones and Paddock fissure and the other to prospect for the downward continuation of the Silver stope. Drifting will be started in the old Emma mine to prospect for an ore zone believed to parallel that productive of ore in the past.

✦ The Wasatch Mines Company is mining ore from its Columbus-Rexall property and preparing to resume shipments from the Flagstaff.

✦ On the Big Cottonwood side of the district, the Kentucky-Utah Mining Company will start driving its main tunnel after a shutdown of eight years. The 6,000-ft. tunnel will be extended a distance of 1,500 ft. to prospect below the old Woodlawn property, where ore was opened up in 1928 in the upper workings.

✦ At the North Lily Mine, in the East Tintic district, leasers are mining ore and the company is driving two drifts on the 1,200 level, one to the north to reach the gold ore area and the other to reach the Tintic Bullion.

✦ Officers and employees of the Tintic Standard Mining Company, operating in the Tintic, Utah, district, celebrated on June 20 at Payson the twentieth anniversary of the discovery of the bonanza orebody by the late E. J. Raddatz. Speeches were made by Superintendent L. R. Dobbs, General Manager James W. Wade, State Senator Eldred M. Royle, and Mayor Philo Wightman.

✦ Assessed valuation of metalliferous mines in Utah for the year 1936 has been set by the State Tax Commission at $61,064,772, compared with $46,038,695 for 1935. Real property of mines has been valued at $8,682,789; equipment and improvements at $21,119,082; and value of ore in place, based on three times the net proceeds for 1935, $31,262,901. Most of the increase in valuation grows out of the advanced price for metals in 1935. Based on 1934 net proceeds, the net proceeds assessment for 1935 was $15,433,224. Two of the largest producers in Utah —the Utah Copper Company and the United States Smelting, Refining & Mining Company—are protesting their 1936 assessments.

✦ The Utah Copper Company reported a valuation of $13,494,166. The Tax Commission set a valuation of $21,103,354. The difference in the figures hinges upon the fact that the Utah Copper Company held over a considerable stock of metal while prices were

THREE HUNDRED TON flotation mill of the Arizona Molybdenum Corporation in Copper Creek, Arizona. The ore treated contains copper and molybdenum and a 95 per cent concentrate is made

low during the depression. The Tax Commission holds the law entitles the State to include the profit derived from this operation as part of the net proceeds. This case has been appealed to the United States District Court. The United States Smelting, Refining & Mining Company is protesting a $3,000,000 increase in assessed valuation. The State has placed a $5,690,754 valuation on the company's properties. The company's valuation is $2,652,289. The Tax Commission contends that a company operating a smelter, mine, and mill only has the right to make a reasonable charge for the treatment of its ores, and has no right to divert a considerable revenue derived from the treatment of mine ores to the operating profit of the mill.

✦ W. F. Snyder & Sons are shipping a carload daily from their Honerine mine, at Bauer, Utah, four cars daily from the Combined Metals property at Pioche, Nev., 35 to 100 tons daily from the Bristol property, near Pioche; one to two carloads daily from the Bluestone mine, at Bauer; and three carloads daily from the Hailey-Triumph property at Hailey, Idaho. Part of the ore is going to the Combined Metals flotation plant at Bauer, and the remainder to the International Smelting Company plants at Tooele, Utah.

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Electrolytic Production of Metallic Manganese

The Electrometallurgical Laboratory of the United States Bureau of Mines, Department of the Interior, will soon disclose the development of a method for the production of metallic manganese from ore by leaching and electrolysis, according to a statement released in Washington June 19. The pure metal so produced, it is said, is in the form of bright, coherent sheets, perfectly stable in air. According to report, the process is simple and cheap and adaptable to commercial utilization. The electrolyte used is manganese sulphate. A method has been devised for maintaining an absolutely constant acidity of the electrolyte.

Power requirements for electrolytic precipitation will not be more than 4,000 kw.-hr. per ton of manganese, the Bureau claims. With large manganese deposits located within reach of power from Boulder Dam and other federal projects, the power cost of producing high-purity manganese metal may be as low as $10 a ton.

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Chrome Ore Imports

Imports of chrome ore during April amounted to 25,380 gross tons, valued at $373,978. Imports, by countries of origin, were: Greece, 1,500 tons; Cuba, 5,561; Philippine Islands, 321; Turkey, 3,500; Union of South Africa, 3,498; other British South Africa, 11,000.

California

New Gold Dredge For Natomas Company

• DIAMOND DRILLING follows extensive mine sampling at Oro Fino —Work started on new cyanide plant for Idaho-Maryland

✦ Construction of a new dredge by Natomas Company, Thomas McCormick president, has been voted by the board of directors. The new unit will replace dredge No. 8, sunk recently, and will cost between $400,000 and $500,000. Its capacity will be about 30 per cent greater than that of the old one, which is now being salvaged for machinery. The new boat is expected to be completed within five months.

✦ Anglo American Mining Corporation, Ltd., Walter Lyman Brown, president, Mills Building, San Francisco, has purchased an additional 60,000 shares of Carson Hill Gold Mining Corporation, under its option agreement, which brings the present holdings of the company in Carson Hill to 770,000 shares. The option agreement calls for the purchase of controlling interest, represented by 1,225,000 shares, which expires in eighteen months. Purchase of the remaining 485,000 shares before expiration date by Anglo American is contemplated.

✦ Oro Fino Consolidated Mines, operating the Oro Fino property in the Ophir district, west of Auburn, has completely unwatered the mine and rehabilitated and sampled about one mile of underground workings, and is now diamond drilling to investigate the position and size of veins parallel to the Oro Fino vein at the 800-ft. level. J. C. Kemp van Ee., Jr., is general manager, with office at 381 Bush St., San Francisco.

✦ According to a report from Los Angeles, Cardinal Gold Mining Company plans to install a new ball mill and classifier to increase the present capacity of the mill to 300 tons. The property is near Bishop, Inyo County, and Victor Bongard is general manager.

✦ Kennedy Mining & Milling Company, Jackson, has completed sinking the main shaft an additional 225 ft. to the 5,400-ft. level, preparatory to starting extensive lateral work. About 185 men are employed under the direction of William Sinclair, superintendent.

✦ Western-Knapp Engineering Company, San Francisco, has been awarded the contract for a complete mine surface plant, including a 50-ton flotation mill, diesel power plant, and water and power lines, by the Carlyle Mining Company, operating at Twentynine Palms. E. W. Ellis is engineer in charge of operations, and construction work is done under Roy Marcellus.

✦ Golden Queen Mining Company, operating the Golden Queen mine, on Soledad Hill, near Mojave, is enlarging its 350-ton cyanide mill by the addition of a new Dorr thickener and an Oliver filter. Larger office space and several new dwellings to house employees are also being provided. W. C. Browning is general manager.

✦ Early construction of a 100-ton mill at the Columbus mine, near Tuolumne, is planned by the Columbus Gold Mining Company. The ten-stamp mill now in operation is running 24 hours a day, and the main shaft has reached a depth of 800 ft. About 40 men are employed under the direction of J. B. Sivori, superintendent.

✦ Work has commenced on the new 350-ton cyanide plant for treating tailings from the Idaho mill at the property of Idaho Maryland Mines Company at Grass Valley. At the Murchie mine, near Nevada City, operated by Empire Star Mines Company, building of a new headframe and installation of hoisting equipment on the new shaft now being raised from the 1,600-ft. level are scheduled to start soon. The raise will reach the surface near the mill, and when equipped will eliminate the incline tram now used to transport ore from the present shaft to the mill. The company has also entered into contract for the construction of a substation and power line to supply 1,000 hp. to the old Pennsylvania mine, in Browns Valley, now under developmet. G. A. Kervin is manager of the Murchie, Pennsylvania, and Zeibright subsidiaries.

✦ Operations are scheduled to be resumed at the Alabama mine, near Penryn, as soon as construction work now nearing completion has been finished. Underground work includes the sinking of the main shaft to 350 ft., straightening of the shaft from the 200-ft. level to the surface, opening of a new working level at 350 ft., and installation of new hoisting machinery on the surface. The capacity of the mill has been increased to 100 tons, and extra equipment has been added to the compressor plant. Deepening of the shaft to 500 ft. is contemplated. The property is worked by the Alabama-California Gold Mines Company, William Anderson, of Auburn, president.

Nevada

Progress at Mountain City Copper Mill

● ARIZONA COMSTOCK improves flotation plant — Engineer's report establishes lower ore reserves at Como Mines

✦ Completion of a 300-ton flotation mill at the Rio Tinto mine of the Mountain City Copper Company, in northern Elko County, by Aug. 15, has been predicted by J. O. Elton, president of Mountain City Copper and manager for International Smelting Company, of which the former is a wholly owned subsidiary. Preliminary excavations and foundations have been completed and steel erection has started on the mill. In recent months high-grade copper ore has been trucked at the rate of 50 to 100 tons per day to Mountain Home, Idaho, whence it is shipped to the International Smelter in Utah.

✦ Improvement in metal extraction by the flotation mill of the Arizona Comstock Corporation, treating upward of 10,000 tons per month, has been effected by the addition of 34 Kraut cells, supplemented by eight Denver Fahrenwald cells. Gold-silver recovery from the highly oxidized ore mined in the great open cut has increased from less than 60 per cent to about 73 per cent, according to a report by **W. J. Loring,** president and managing director, who returned lately from New York. It is the purpose to complete the partly constructed 500-ton cyanide leaching plant and to refloat and leach the flotation tailing, a large volume of which is impounded below the flotation mill. Concentrate shipped in May had a value of $1,480 per ton, and gold traps between the ball mills and classifiers are recovering around $200 per day.

✦ Major stockholders of the Como Mines forced a reorganization of the directorate late last year for the purpose of securing an unbiased report for the stockholders. Accordingly a report was recently made by C. W. Van Law, consulting engineer, covering the period of mill operations from last summer to April 1. The report indicated that extended development in the Como and Rapidan sections has established reserves considerably less in volume than were estimated in earlier reports. Stoping by the shrinkage method proved impracticable by reason of the absence of a hard hanging wall, and ore from the Rapidan vein is too highly oxidized for successful treatment by flotation. Until recently the 300-ton flotation mill had been operated on one shift daily. Shortly after the report was issued, however, it was reported that the Como heading of the Boyle haulage tunnel had entered good ore and that mill heads were higher. Deep winzes are to be sunk in the Como and Rapidan veins from the haulage level.

✦ An orebody of promise has been opened in a hitherto unexplored part of the Justice mine, in the Comstock district. It is one of early producers and is known as the Silver City fissure, taken under long-term lease lately by the Dayton Consolidated Mining Company from the Comstock Keystone Company, which purchased the property last year. Ore from the Justice is treated in the Dayton's 150-ton cyanide mill.

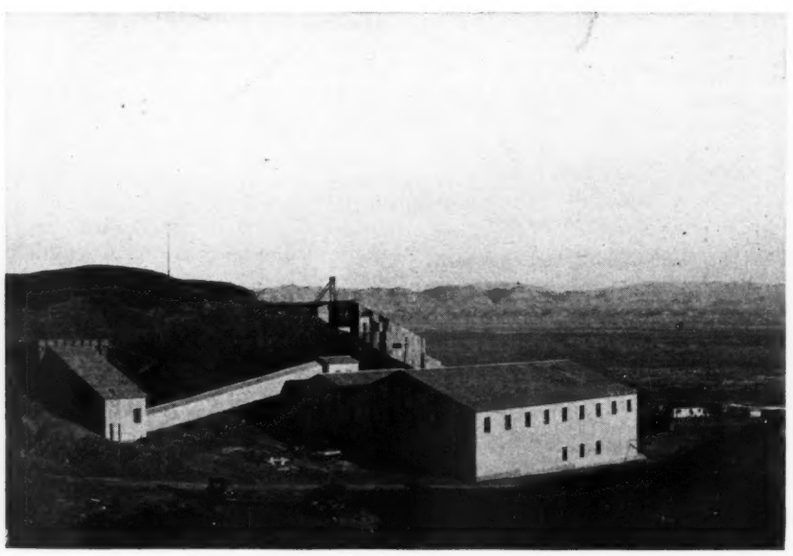
✦ Operation of the 400-ton flotation mill and cyanide leaching plant of the Stone Cabin Consolidated Mines, Inc., in the northern part of the Como district, is to be resumed within 60 days, it was announced here by G. C. Snyman, vice-president and manager. Since closing the mill, several months ago, the company has employed a force of about 25 men on developing in its Pony Meadows and Mount Lincoln mines, under direction of Glen G. Gentry, engineer and superintendent. Officers elected at a recent meeting in Philadelphia include J. N. Darrow, of New York City, president; G. C. Snyman, Merchantville, N. J., vice-president and manager, and E. W. Freeman, of New York City, secretary and treasurer. W. W. Charles, originator of the project, with present headquarters in Los Angeles, continues as board chairman.

✦ An option on control of the Black Mammoth Consolidated Mining Company is said to have been acquired lately by E. L. Cord, automobile manufacturer and associates, from Fred Vollmar, Jr., organizer and president. Black Mammoth has a ten-year lease on the Mary mine of the Pittsburgh Silver Peak Company at Silver Peak, Esmeralda County, and late last year built a 100-ton cyanide mill after operating a small mill with pronounced success for several years. The Mary mine, on which the Pittsburgh company at one time operated a 120-stamp mill, the largest in Nevada, now ranks among the foremost gold producers of the State.

✦ A large body of low-grade gold ore, opened a short time ago near the north end of the Osgood range in eastern Humboldt County, is being developed by N. H. Getchell, president and manager of the Gold & Silver Circle Mines, Inc., with Reno associates, reported to include George Wingfield. Connecting roads, a millsite, and a water line have been surveyed and a tunnel is being driven to undercut a large outcrop.

✦ A 50-ton mill employing amalgamation and gravity concentration is nearing completion on property of the Arrowhead Development Company in the Sweetwater range in Douglas County, 3 miles from the California line. A 1,400-ft. gravity water line has been completed. A substantial reserve of high-grade mill ore has been developed to the 300-ft. level. The veins are quartz-filled fissures in andesite, the metal content virtually all gold. Peter Fox is president and manager in charge.

BLACK MAMMOTH Consolidated Mining Company's 100-ton cyanide mill at Silver Peak, Nev. The mine is about six miles away and the ore is transported to the mill in 10-ton trucks.



NEWS FROM WASHINGTON

By Special Correspondent

CONGRESS adjourned in a flurry of activity that carried several bills to enactment which business has vigorously protested. The Patman-Robinson bill aimed primarily against chain stores and mail-order houses prohibits discrimination in prices among customers buying equivalent quantities of goods shipped in interstate commerce and empowers the Federal Trade Commission to fix maximum quantity discounts. An amendment sponsored by Senator King, of Utah, and adopted by the Senate specifically exempting mineral and metal products was stricken out in the conference committee of the two houses. The worst feature of the bill also was eliminated, however. By condemning the basing point system, the law would have dealt a blow to delivered price systems which have long been a customary trade practice in the mining industries.

Only of indirect effect to the mining industries is the Walsh-Healey Act, which provides that Government contracts in excess of $10,000 shall be awarded only to employers observing a 40-hour week and paying wage rates prevailing in the locality as determined by the Secretary of Labor. The law apparently will apply only to the person or firm which enters into a contract with the Government, although a broader interpretation of the law would make the contractor responsible for compliance with its terms by the concerns from which he purchases materials which enter into the product delivered to the Government. The extent to which the law may be extended in this fashion will only be revealed in its administration. The NRA was not successful in establishing the responsibility of one firm for the acts of others from which it purchased merchandise for resale.

While other industries share the mining industries' opinion of the new tax law, the levy on undistributed earnings places a direct handicap upon the development of mining properties. A mine that has reached the stage of full development and has adequate depletion reserves may be able to distribute its net earnings each year. This is not true, however, of a mine in process of development or of a mine which has not reached full production. Earnings of such mines should be available for building up and equipping the property. Because mining is an extractive process this is true to a greater extent in mining than in manufacturing enterprise, and it is for this reason that the new law will impose a peculiar hardship upon many mining companies.

Only in one particular can the tax law be regarded with satisfaction. This relates to the provision (Sec. 112(b) 6) for the simplification of corporate structures. As written in the Revenue Act of 1935 it was not effective, but it is expected that adoption by the conference committee of suggestions made by the American Mining Congress will permit liquidation of subsidiary corporations without the risk of uncertain and unknown tax consequences.

World Mineral Situation

● Many minerals and metals are of international significance. Study of only domestic aspects may, therefore, give wholly inadequate information regarding important trends which affect both producers and users of this country. Recognizing these facts, the Bureau of Mines is planning to initiate during the fiscal year just opening a world-wide mine survey.

Exact details have not been worked out as to the way in which this project will be carried forward, but it is contemplated that at least maps of mining districts and a résumé of production data will be gathered in the near future. This will represent, primarily, an expansion of the present work of the foreign minerals section of the economics branch of the Bureau. As the work goes on it is hoped that complete geographic, geologic, resource, and reserves data can be added to the undertaking.

Effect of Sanctions

Restrictions of mineral supply to belligerents by sanctions will not work. This not too surprising conclusion is explained by Washington with an illustration, apparently reliably described as follows:

An important British ferro-alloy agency had profitable opportunity to sell ferrochrome to Italy during recent months. The alloy was loaded from a British port for Marseilles, France, from which it was reconsigned to Yokohama. At this Japanese port it was reloaded for delivery to New York, at which port another transshipment sent it on its way to Italy within the letter of the law.

Those who do not think the munitions-control policy will work are answered, when they describe this example, by others who point out that delay caused by this indirect movement is almost as serious to a belligerent as though sanctions actually worked effectively. Furthermore, the delivered price of the ferrochrome described in the example given was reported as nearly double the prevailing world price. Thus, proponents argue, a belligerent suffering both delay in receipt and excessive treasury burdens, because of indirect handling, is enough handicapped to make sanctions worth while.

Stream Pollution

The mining industry now realizes that Federal regulation of stream pollution is on its way. This fact has been made evident during the last session of Congress by the large number of legislative proposals introduced by various members of Senate and House committees which have any concern with rivers, harbors, or interstate waterway problems. The number of bills involved may have been a factor in preventing action at an earlier date; but this number also is a proof that when suitable compromise is worked out there will be legislation having general importance for many divisions of the industry.

Other industries interested as well as spokesmen for mining appeared at several series of Congressional hearings. No composite recommendation has yet evolved. It is evident, however, that members of Congress are being more than ever impressed with the necessity of handling this important subject through a high-grade technical agency. It is too soon to say whether the proposal will prevail that the Public Health Service be given complete charge. More progressive of the critics of some legislative measures feel that such a decision is ultimately necessary. The experience of several of the industries, notably the chemical manufacturers of the country, in dealing with Public Health officers, makes it clear that no unworkable or unreasonable results would come from the correction of stream pollution matters by that service.

An effort will probably be made next January to draft a bill which can have rather general support. It is expected that the leaders of the various interested industries affected by such legislation will cooperate during the next six months with suggestions on which there can be drafted a bill for prevention of unnecessary pollution without imposing impossible hardships on go-

ing enterprises. Disposal of mill tailings into streams is perhaps the most difficult of the problems to be solved for the metal-mining industry. Seepage of acid mine waters into streams near populated communities is another problem to be considered.

Bleaching Clays

Deposits which promise important industrial development for bleaching clay for use in refining petroleum are described in several preliminary reports of the United States Geological Survey recently presented by G. R. Mansfield. The documents relate to various states in which special studies have been made during the past two years.

In four Florida counties, Jackson, Jefferson, Leon, and Washington, deposits have been identified which seem to promise successful development. Referring to this material Dr. Mansfield emphasizes the commercial possibilities in the following language: "The significance of the discovery is that the better grades of activable clays, when properly treated, are from two to five times as efficient in bleaching action as fuller's earth of commercial grade. Activable clays contain altered volcanic ash and are commonly called 'bentonites' or 'bentonitic clays.' The naturally active clays (fuller's earths) are ordinarily not improved in bleaching power by acid treatment—in fact, many of them lose part of their activity when so treated."

Another report by the same author describes certain Alabama ceramic claims which indicate possibilities of development of kaolin and plastic refractory clays in several counties of Alabama. This report, one on Tennessee and Kentucky, and a number of others in preparation, indicate the new emphasis being placed by the Survey on the non-metallic minerals of the South. A number of such industrial developments are hoped for now that funds for commercialization of projects are more readily available.

Surcharges Expire

Ores and ore concentrates were exempted by the Interstate Commerce Commission in authorizing continuance of the emergency freight rate surcharges until Dec. 31. The effect of the Commission's action was to allow the surcharge on ores and concentrates not otherwise indexed by name in railroad tariffs, to expire June 30.

Copper, lead, and zinc ores and concentrates were exempted when a surcharge of 7 per cent, maximum 2c. per 100 lb., was applied to ores and concentrates not otherwise indexed by name, April 18, 1935. The confusion that resulted was described by the Commission as its reason for lifting the charge.

Many line-haul rates in the West apply on ores and concentrates not otherwise indexed by name, although the principal content of the ores moving on such rates often is copper, lead, or zinc. It was frequently difficult to determine whether a particular shipment of ore was or was not subject to the charge applicable to ores in the not otherwise indexed by name group. For this or other reasons, several railroads removed the charge applicable to such rates. The Commission concluded as a practical matter that no distinction may be made between ores and concentrates not otherwise indexed by name and those designated as copper, lead, or zinc.

Forecasts of Demand

● It is proposed that a new service be established by the Government giving quarterly or perhaps monthly forecasts of demand for copper, lead, and zinc. If this project is authorized to begin during the fiscal year which opened July 1, these three major non-ferrous metals will receive attention first.

In carrying out this project the Bureau of Mines will follow the pattern laid down in corresponding studies of needed petroleum production and prospective gasoline consumption. Regular reports from the field will be received as to rates of production, stocks on hand, and shipments. In fact-finding fashion the data will be formulated to show probable need during the next month or quarter for each commodity studied.

It is possible that a like service may be developed a little later with respect to certain of the non-metallics important for the construction industries. Cement, lime, stone, sand and gravel, and other such building materials will be considered for this service. The economics branch of the Bureau of Mines has authority for these investigations under its general power. The rate at which the work will be undertaken and the detail which will be possible are, therefore, determined solely by the funds available for the work.

Mine Technology Study

The mining industry is to be investigated, along with others, to determine what are the outstanding trends in employment and how reemployment may be afforded. This is a part of the broad project being conducted under the direction of Dr. David Weintraub, of the Works Progress Administration, with headquarters in Philadelphia.

The Bureau of Mines is furnishing technical advice and some supervision of the statistical inquiries. Most of the employees are, however, supplied from the lists of those eligible for WPA aid. It is hoped that this inquiry will develop facts regarding the mining industries' employment problems as these are affected by mechanization, prices, rate of mine operation, and other business considerations. The inquiry will be of a fact-finding type. Any policy-making conclusions drawn later will be formulated in Alphabetic offices, not by the Bureau.

Wholly independent, but somewhat correlated in significance, is the employment feature of the current census of mines and quarries. This project, which relates to production during the calendar year 1935, is a half-decade special inquiry, an extra in what is normally a decennial-census series. As the returns are received an effort will be made to correlate the reports of the industry to show what relation production has to employment for each of the major divisions of the mining group. Here again the work of the Bureau of Mines is advisory with respect to technical features. The prime responsibility is assumed and the bulk of the statistical work is being done by the Bureau of the Census, as usual.

Tin Troubles

With American tin-plate producers working at 100 per cent of rated capacity or faster, there has been a building up of tin-plate stocks rather than stock of pig tin. The consumption of the rest of the world has also been stimulated, but nothing like as much as that of the United States. One of the important British tin companies estimates the 1936 requirements of the United States, expressed in tons of tin pig, as follows:

	Tons
For tin plate	30,000
For bronze, tubes, and foil	10,000
For babbitt, solder, and other alloy uses	25,000
To rebuild users' stocks	7,000

Consequently, important requirements of the United States are expected to be 6,000 tons monthly for this calendar year. Notable in the discussion on which the foregoing estimates are made is the fact that increasing automobile building is not producing corresponding increase in tin consumption. Consumption of this metal per car is slowly but definitely declining.

Washington comment on the industry situation suggests that more adequate tin supply, and even a price cut, might be expected were it not for the Bolivian situation. To retain Bolivian interests in harmony with Cartel policy it is necessary to maintain a higher price than is needed by the rest of the world for profitable operation at near-capacity rates. Cartel leaders fear that American smelting interests would be stimulated in cooperation with Bolivia if that country were not given the prevailing price assured it by present Cartel policy.

King Solomon Company To Diamond Drill

● MINERAL MOUNTAIN MINING development continues favorable —Nancy Lee mine expects to reach objective soon

✦ Under the direction of Jean Peters, geologist, a diamond-drill campaign will start at the property of the King Solomon company, located in the Fourth of July Canyon district about a mile north of Armstrong's camp. C. H. Nethaway, of Everett, Wash., is president of the corporation and W. J. Coleman, secretary.

✦ A crosscut north toward the footwall from the face of the west drift at the Mineral Mountain Mining & Milling Company on Spring Gulch has encountered the best showing yet disclosed in that property. About two feet of quartz and massive iron pyrite is reported, with heavy layers of siderite, coming in along the bottom of the crosscut in the first round and later opening up to the back as the work progressed. Drifting for the past 200 ft. has been along the hanging wall of the vein, where ore indications are encouraging. About 800 ft. of underground work has been accomplished. The showing is said to be pronounced as typical of the gangue in the Sunshine and Polaris veins and is thought to strongly indicate the presence of an orebody near by.

✦ Archie Carother, employed at the Page mill, has been sent by the Federal company to the Azurite mine, in the Cascades, to superintend the erection of a milling plant at that property. It is expected to have the mill in operation about Sept. 1. The Azurite mine is being developed by the American Smelting & Refining Company with Federal company engineers in charge.

✦ An important ore disclosure was made at the Chester property in a crosscut extending northward from the Silver Summit-Polaris tunnel, which reached the Chester vein at a point approximately 400 ft. east of the old Chester workings. The vein is reported to be 5 ft. in width, with contents similar to the showing in the former workings, which yielded high tonnage of commercial ore. The ore contains principally silver, with some lead. The Chester group is under control of the Polaris company, a subsidiary of the Hecla Mining Company.

✦ The property of the Nine Mile Mining Company, located on both sides of the west fork of Nine Mile Creek, three and one-half miles northeast of Wallace, is attracting favorable attention from mining men of the district at this time, as plans for a comprehensive development of the vein system are being made by the management. The group consists of 23 claims, covering 450 acres, with a length of 9,000 ft. and from 1,600 to 2,400 ft. in width. Part of the ground has been patented. Officers of the company are S. H. Linn, president-manager; Walter H. Hanson, vice-president; Otto A. Olsson, secretary-treasurer. These officers, with O. H. Linn and Sam Hammer, comprise the board of directors.

✦ At the annual meeting of stockholders of the Metropolitan Mines Corporation, held in Wallace, directors were named for the new term and reports of operations during the past year presented by the officers. Manager R. S. Merriam reported the shaft is down to the 340-ft. level. The objective is 400 ft., from which point crosscuts will be extended to the vein. On the 200 level gray copper was reported found which assayed 24 oz. silver. R. L. Brainard, of Wallace, is president.

✦ The Nancy Lee is attracting attention from mining men in the Northwest. Alexander Leggatt, geologist and engineer, of Butte, is in charge of operations, and Frank Eichelberger, vice-president of the Sunshine Mining Company, is consulting engineer. In May the tunnel was advanced 326 ft. It has now passed the 1,100-ft. station and is expected to reach the King and Queen vein early in July. A body of commercial silver-lead ore is hoped for at this connection, which is about 800 ft. below the shaft of the upper workings in which rich silver was found.

✦ Diamond drills are reported to have found a body of lead-silver ore below the deep level at the property of the Liberal King Mining Company, located on Pine Creek, near Beeler station, according to Manager Henry Weber. Two drill holes have found ore 100 ft. below the tunnel level and the cores indicated a width of 42 in. of commercial ore. A third hole will be started to explore the vein further.

✦ Two mines on Willow Creek, in Boise Basin, are producing ore for custom shipment at the Twin Sisters mill, at Centerville. Barton & Gordon, Inc., operating the Lippincott & Warner property under bond and lease, are said to be getting good pay from a gold vein 24 in. wide.

✦ The Belshazzar mine, at Quartzburg, in Boise Basin, which once paid $80,000 in dividends, is inactive at present, but a late report states that John Murnan and Fred Brassey have opened one of the Belshazzar veins in virgin ground of the Mountain Chief about 250 ft. from the Belshazzar end line. The Mountain Chief has a mill ready to start when the lessees have sufficient ore to assure a steady run.

✦ The Mountain Queen Mine of the Golden Age Mining Properties, located at Pioneerville, in the Boise Basin mining section of Idaho, has been under lease since July, 1935. A crosscut tunnel 300 ft. long has been driven to the Queen vein, and two drifts on the vein have been made. Several months ago a raise was put through to the surface from the face of the main tunnel, at an angle of 45 deg. This operation revealed a new vein which carries gold and silver in commercial quantities. At present all work is being concentrated here. Plans are to ship this ore to a custom plant or erect a mill on the property. Richard F. Reynolds is agent for the company.

✦ Preparations for the development of the Gem of the Mountains, a property on the Payette slope of the Golden Age in Boise Basin, are being made by the owner, Dr. C. C. Fairchild, of Centerville. Since 1919 he has proceeded at intervals on a long tunnel, which is almost completed.

●

Bureau of Mines New Building in Alabama

The new building of the Southern Experiment Station of the United States Bureau of Mines, Department of the Interior, on the grounds of the University of Alabama, Tuscaloosa, Ala., was dedicated on May 26. Addresses were given by Dr. George H. Denny, president, University of Alabama; Dr. John W. Finch, Director, United States Bureau of Mines; and Milton H. Fies, vice-president, De-Bardeleben Coal Corporation.

The work of the Southern Experiment Station, which functions under a cooperative agreement with the University of Alabama, has been devoted mainly to studies of methods and means for improving the processes whereby ores and mineral products are prepared for commercial utilization, and to investigations of ore mining methods. The coal and ore preparation studies have dealt with coal and metallic and non-metallic ores of the Southeastern States, including iron ore, clay for mineral fillers, bauxite, phosphate rock, graphite, Southern gold ores, barite, and kyanite. Reports have been published giving the significant results of these investigations. There is a large variety of metallic and non-metallic ores in the Southeastern States served by the Southern Experiment Station, and the majority of these ores are of the low-grade type, presenting difficult problems in their preparation for successful and profitable commercial use. The new building makes available physical facilities which should aid greatly in solving some of these problems.

Tri-State

Zinc Ore Production Curtailed

● **OPERATIONS may be further decreased during summer months**

✦ Activities in the Tri-State mining district, which began the year with such a roseate hue, have been greatly hampered by a slight overproduction, which has been magnified by a lack of demand from the zinc smelters. This lack of demand has been brought about by a desire of the smelters to reduce zinc concentrates at plants, which accumulated stocks late last year and the early part of this year. A contemplated curtailment of zinc ore production of 10 per cent, started ten weeks ago, was only 50 per cent effective, that is until the tenth week of the period. At the end of the ninth week many mines of the district found bins overflowing with ore and bank accounts depleted, and were forced to shut down. Production, which early in the year soared to 10,800 tons and was well on its way to break the 11,000-ton mark, was cut to an average of around 9,600 tons a week when it became evident that curtailment was needed. In the eighth week of the contemplated curtailment period the production declined to 8,500 tons and in the tenth week it dropped to less than 7,500 tons. It is evident that unless something is done to cut the surplus stocks, which have climbed from 21,000 tons as of Jan. 1 to 37,500 tons as at the end of June, the price of zinc concentrate, which has stood at $32 a ton for 37 consecutive weeks, is going to be broken. The thought has been the father of a suggestion for a 40 per cent reduction in production for July and August. Unless some companies can dispose of ore the idea may reach fulfillment. At least there is going to be some reduction in output by either voluntary or forced means.

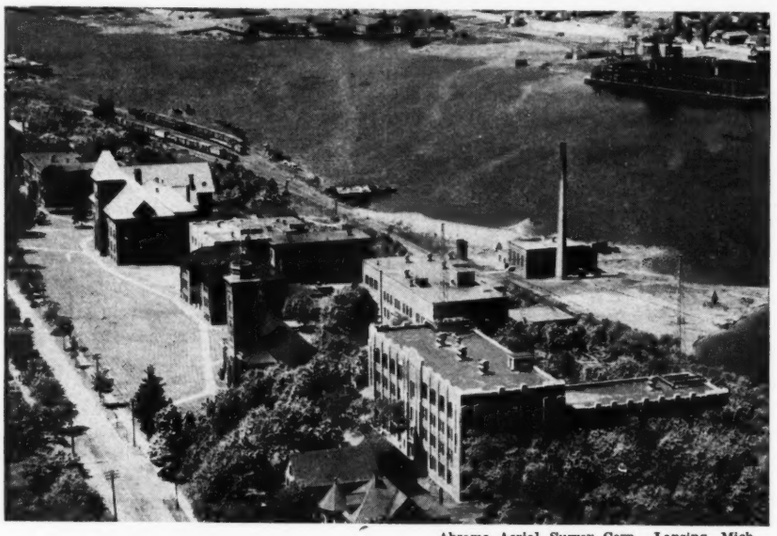
✦ The decline in the London price of zinc in June depressed the domestic zinc market and competition among domestic producers increased in the face of slow buying. This resulted in a drop in the price of zinc metal from 4.90c. to 4.85c. on June 18. The statistical position of domestic zinc, however, continues good.

✦ The Mutual Mining Company has obtained a lease on two tracts of land owned by the American Zinc, Lead & Smelting Company in the Oronogo district and will start mining the leases immediately, according to W. Guy Waring, Webb City. A derrick and hopper have been constructed on an old shaft on the Mutual lease and the ore from the two tracts will be hauled underground to this shaft. The ore will be treated over the Central mill of Eagle-Picher Mining & Smelting.

✦ The Lead & Zinc Corporation has installed a 10-in. Texas pump on the Glover land, west of Joplin, and will start sinking a shaft on the lease immediately. The ore will be milled over the company's mill near Chitwood, in the city limits of Joplin. R. A. Hartley, of Joplin, is manager of the company.

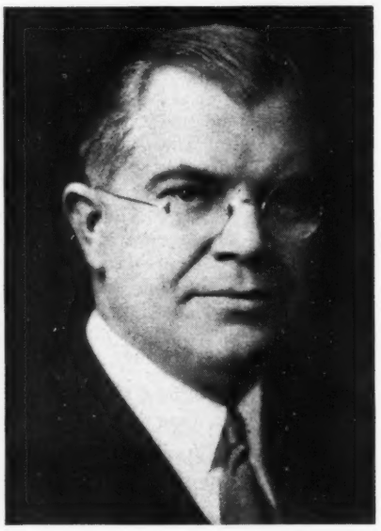
✦ The Rialto Mining Company, Douthat, Okla., has completed the installation of a 10-in. Peerless pump on its lease with which to dewater the tract down to the 350-ft. level, according to Sam Ashe.

✦ The Galena Mining & Milling Company has just completed the installation of three flotation machines, an American three-disk filter, and other equipment at its plant at Galena, according to R. L. Wagnon, of Joplin.



Abrams Aerial Survey Corp., Lansing, Mich.

Michigan College of Mines to Celebrate 50th Anniversary



● **GROVER C. DILLMAN, new president, will be inaugurated on Aug. 6**

✦ In a combined 50th anniversary celebration and alumni reunion, the Michigan College of Mining and Technology, at Houghton, will be host on Aug. 5, 6, and 7 to many hundreds of its 3,500 living former students and to a thousand honor guests invited for the inauguration of Grover C. Dillman as president on Aug. 6.

The program also includes an alumni association meeting, campus luncheons, fraternity, group, and class dinners, trips to mines, mills, and smelters, a dance, smoker, and parade, and entertainment for the wives and daughters of alumni and guests.

Many of these events are traditional parts of the five-yearly alumni reunion exercises. New on the schedule will be the dynamic exhibits set up in most of the nine college buildings to illustrate the progress of the engineering profession and of Michigan Tech since 1886, when the institution was established as the Michigan Mining School.

The executive committee for the August celebration consists of the board of control, headed by Vice-President A. E. Petermann of the Calumet & Hecla Consolidated Copper Company, and President Dillman. Dr. James Fisher is general committee chairman.

✦ The new circular, reinforced-concrete drop shaft of the Copper Range company, in Globe lands, is bottomed at water level, 103 ft. in depth. It will not

be sunk to solid rock, as the old shaft with which it connects is in good condition. Timbers have been repaired and strengthened and the old shaft will be deepened from its present depth of 1,000 ft. about 700 ft. to connect with the 18th level drift from the Champion mine. A hoist has been installed. Good ore has been opened in the 18th level, and another drift is going in at the 9th level. This development will give Copper Range another good copper producer on the Baltic lode.

Colorado

Silverton District Active

● MAYFLOWER MILL treating custom ores—Many inquiries about Colorado mines received by Mines Commissioner

✦ The Shenandoah-Dives Mining Company, under the supervision of C. A. Chase, has started treating custom ore in the mill. About 100 tons per day comes from the Pride of the West and 20 tons per day from the Fanny. The mill and lower end of the tram line to the Vertex burned last winter, and when the erection of a new terminal station is completed, around July 1, ore shipments of 50 tons daily will be made to the Mayflower Mill.

✦ The Banner American Mining Company, under the direction of G. A. Franz, has opened the Dunmore mine, on Mount Hayden, about 5 miles from Ouray, Colo., on the Ouray-Silverton Highway.

✦ The Carter Mining Company at Ohio City, Colo., operating a Hadsel mill, is treating about 90 tons of ore a day. The haulage tunnel extends underground about 8,800 ft. and ore is dropped from above the tunnel into a winze 1,800 ft. deep which connects with the haulage tunnel. This great drop is said to break the ore sufficiently so that it can be fed directly to the ball mill. C. M. Carter is manager.

✦ John T. Joyce, Colorado Commissioner of Mines, states that letters from many parts of the world are reaching his office for information about mines of all kinds. The number of persons seeking information about Colorado mines is greater than at any other time since the office was established. In 1934 metal production in Colorado was 125 per cent over the record for 1933 and 17 per cent greater in 1935 than in 1934.

✦ The Blue Moxie Leasing Company, of Independence, Colo., is sinking its shaft 500 ft. from the 22d to the 27th level. W. L. Fitzgerald is president.

Mexico

Labor Troubles Appear To Lessen

● SUPREME COURT RULES labor boards must abide by their agreements — Many small placer miners active in Sonora

✦ Fewer labor troubles, more or less important development work in several regions, more emphasis on the tendency to increase wages, and greater activity of prospectors in northwestern and central zones marked the advent of summer in the Mexican mining industry. Intervention of the Federal Labor Board nipped some strike movements in the bud and straightened out other employer-employee difficulties.

✦ Asarco Mining Company has raised labor wages to a daily rate of 3.10 to 3.60 pesos for underground workers and 2.90 to 3.10 pesos for surface employees of its Santa Barbara unit, in Chihuahua.

✦ More labor trouble for the Guanajuato Reduction in its Guanajuato City unit was forestalled by company agreeing to pay employees for three Sundays and four extra days' service, compensate dismissed workers with four days' wages each, and dismiss eight men whom the miners' union disapproved. The company is working all its mines excepting the Valenciana, where ore is exhausted.

✦ Cia. Minera y Metallurgical El Potosi, S. A., has won a Federal Supreme Court injunction restraining the Chihuahua Government from embargoing its property to secure collection of a tax claim of 511,152.67 pesos (approximately $152,500 U. S.) and from cancelling company's concession which was granted in 1924. The tribunal held that collection of taxes would be retroactive, as the franchise allowed the company certain exemptions from Chihuahua levies. The court also held cancellation of the concession unjustified.

✦ Mexico's Supreme Court established a precedent for mining and other firms in Mexico when it ruled that labor boards must abide by their own decisions and allowing Cia. Minera Dos Carlos, S.A., operating at La Reforma, Hidalgo, an injunction against the Hidalgo labor board, changing its decision to allow the company to dismiss some workers of its La Necesidad mine. A permit was granted in 1933, but the board later revoked it.

✦ The Xitinga plant of Cia. Minera de Chontalpan y Anexas, S.A., operating at Tetipac and Chontalpan, Guerrero, treated 3,918 tons of ore in April which averaged 1.58 grams gold and 518 grams silver the ton. In March, the plant treated 4,347 tons that averaged 1.44 grams gold and 427 grams silver the ton. Net April production was 3 kg. 752 grams gold and 1,786 kg. silver. Net April profits were 4,237.11 pesos (about $1,248 U. S.).

✦ Prospectors are prospering by working recently discovered gold placer deposits in the Alamoa, El Tiro, El Boludo, Tecoripa, La Colorado, and Magdalena regions, Sonora. Discovery of two huge nuggets, one weighing 800 grams, at El Tiro, and another of 350 grams at El Boludo, is reported. Prospectors are also thriving by working placer deposits along the Monte de San Nicholas, Santa Rosa and Los Placeras rivers, Guanajuato, and extracting gold and silver from ores discarded on several abandoned treatment haciendas in that State.

✦ Cia. Mexicana Exploradora de Minerales y Metales, S.A., is doing development work on the Pantano, Santa Ana, Paulina, and Aureola de Oro claims in Compostela municipality, and on the Jorge, Don Felipe, Maria Victoria and Felipita tracts, El Tigre region, Huajicori municipality, Nayarit.

✦ Labor troubles of Cia. Minera de Montecarlo y Anexas, S.A., operating at Tetipac, Guerrero, have temporarily ended with the intervention of the Federal Labor Department that terminated a strike soon after it had started. The workers consented to arbitration of their differences, a feature of which is a demand for a new collective work contract.

✦ Milling of 350 tons of ore daily is being done by the Guanajuato Consolidated Mining at its Guanajuato unit, which is supervised by General Manager Alfred Wandke.

✦ The San Francisco Mines of Mexico, Ltd., treated 33,780 metric tons of sulphides and 15,180 metric tons oxides during May. Lead concentrates produced amounted to 5,489 metric tons and zinc concetrates produced were 1,528 metric tons.

✦ A miners' cooperative society has asked the Federal Government to grant it a loan to exploit five gold, silver, and iron deposits near Tarimoro, Guanajuato, to prevent the property from falling into the hands of foreigners.

✦ The opening of the New Pan-American highway from Laredo to Mexico City was officially made on July 1. The road is 763 miles long, has filling stations averaging 26 miles apart (greatest distance is 68 miles), and eight general repair shops are available. Two days is considered average traveling time for the trip.

Canada

Red Lake Mining Activities Increase

GOLD EAGLE plans construction of mill—Improved highways to mining districts

✦ The Red Lake camp has now definitely come into its own, and a large number of the meritorious prospects are being tested in a conclusive way. The position of Howey has not yet improved, and its future depends upon finding ore of better than the present mine grade in the levels now being opened from 1,500 to 2,000 ft.

✦ Red Lake Gold Shore, adjoining Howey on the west, has a 150-ton mill under construction which has an ample supply of half-ounce ore from levels down to 500 ft. W. P. Mackle is manager.

✦ Madison Red Lake, just to the west, is distinguished by being in an area of massive granite. The ore grade is one-third ounce or better, and a mill is contemplated. A. H. Housberger is manager.

✦ The latest property to become established is Gold Eagle, adjoining McKenzie Red Lake on the south. Development of a vein to the west had given inconclusive results, and recently a 1,000-ft. crosscut was driven on the 500 level to intersect the extension of the north-south McKenzie shear zone. This has disclosed high-grade ore in sufficient volume to warrant a new shaft and plans for a mill. F. M. Passow is manager. The Ontario Hydro-Electric Power Commission has started to double its plant at Ear Falls to 10,000 hp. to serve these mines.

✦ The Little Long Lac area now has two more mines assured. McLeod-Cockshutt, on which the original development was disappointing, has now indicated, by drilling, an extensive ore zone with values ranging half an ounce. This zone extends eastward into the adjoining Hard Rock property, where drilling has indicated ore of similar dimensions and grade. On both, shafts are being sunk, with the first objective at 500 ft. Hard Rock has another ore zone 3,000 ft. to the east which is partially developed to 450-ft. depth. It is possible that both properties may develop into mines of medium grade and comparatively large tonnage. The Little Long Lac mine continues as a high-grade mine of 250 tons' capacity. An ample power supply is available from the Wipinger plant of the Ontario Hydro-Electric Power Commission.

✦ With Pamour's new 500-ton mill operating on $8 to $9 ore, this eastern section of the Porcupine camp has become very active. Drilling on the Hallnor property, adjoining on the west, has given results that suggest a repetition on a somewhat smaller scale of the Pamour ore conditions. Hallnor is controlled by Noranda Mines and is named after Oliver Hall, of that company, to whose initiative is due Noranda's interest in this field. A. L. Sharp is manager.

✦ Following the development of its "new mine" to the northeast, Dome Mines has purchased the Schumacher veteran claim to the north of the old mine and is already assured there of orebodies of first-rate importance. Dalmite, subsidiary of Sylvanite, has found sufficient ore on three levels to consider a mill. Buffalo-Ankerite, at the end of this northeast-southwest line of mines, has recently found a substantial volume of high-grade ore, the first to be found in the twenty years of its history.

✦ In the Kirkland Lake camp, the recent discovery of high-grade ore on Bidgood has stimulated a renewed search for ore on most of the properties between it and Toburn. Moffat-Hall, adjoining Bidgood, shares its newly found ore zone. At the west end of the camp Macassa has now developed important shoots of ore on the 3,000 level throughout the larger part of the property's length of 4,000 ft. A subshaft at this level designed to reach depth of 6,000 ft. is now under way. At 3,300 ft. in the adjoining Kirkland Lake Gold mine high-grade ore in substantial volume has been found for the first time in this mine.

British Columbia

✦ The construction and improvement of roads and trails into mining areas will be undertaken on a considerable scale this summer under an arrangement recently concluded between the Dominion and provincial governments. The Dominion voted $1,500,000 to be used for this purpose throughout Canada, of which $300,000 has been apportioned to British Columbia. The Province, in addition, will contribute $150,000, bringing the total amount to $450,000.

✦ The Bridge River mining field is particularly active this year, and encouraging results are being obtained, not only at the two major producing mines, Pioneer and Bralorne, but also at numerous smaller properties. A detailed account of developments in the new low levels at the Pioneer was presented at the recent annual meeting by the general manager, Dr. H. T. James. At the sixteenth level, in the east drift on the main vein, 206 ft. of ore has been opened, varying in width from 2.8 to 3.7 ft., of which the best section, 52 ft. in length, averaged 2.597 oz. gold. On Level 20, ore has been opened to the east for 70 ft. In the west drift a 36-ft. length averaged 2.764 oz. gold across a width of 1.6 ft. Ore is also being developed at the 23 level, and it is expected the vein will soon be encountered at No. 26, the lowest level, 3,200 ft. beneath the surface.

✦ A record production was established at the Bralorne in May, when 5,669 oz. gold, valued at $199,465, was recovered from 14,522 tons of ore milled. A new oreshoot understood to carry exceptionally high values has been developed from a length of 150 ft. to date in the Ida May vein in the tenth level east drift. Connection will soon be made between the eighth level main crosscut from the King workings and the Empire shaft.

✦ In the northern section of the Bridge River field, the Minto mill has been enlarged from 60 to 120 tons. The orebody developed in the River tunnel for a length of 400 ft. is now being opened at greater depth in a winze which will be sunk 125 ft. below the tunnel, where lateral work will be commenced. D. H. Matheson is general manager.

✦ At the Pacific Eastern, adjoining the Pioneer mine to the east, a vein 12 in. wide and carrying 0.58 oz. has been opened to date for a length of over 100 ft. in the west drift on the 500 level.

✦ Milling at the rate of 150 tons daily was resumed recently at the Cariboo Gold Quartz, adjacent to the Island Mountain, after an interruption of several months caused by the destruction of the power house by fire. Machinery has been installed for handling 275 tons a day, but this rate will probably not be reached before the end of the year.

✦ The season's work has been commenced at Bullion Placers, the largest operation of this type in the province. The pits are situated on the south fork of the Quesnel River, 60 miles from Williams Lake. What is believed to be the largest monitor on the continent was installed last year. The diameter of the nozzle is 10 in. and that of the intake 18 in. There is a 380-ft. head of water. It is expected to wash 1,000,000 cu. yd. of gravel this year. R. F. Sharpe is president and manager.

✦ During May at the Vidette, near Savona, in the Kamloops district, 735 oz. gold was produced from 947 tons of ore milled. The "361" oreshoot has been developed for a distance of

437 ft. to date at the third level. A winze has been started in the orebody, and at 20 ft. above the level it assayed 2.42 oz. across a width of 20 in.

✦ The Morning Star and Fairview Amalgamated properties near Oliver, in the Osoyoos district, were consolidated recently by agreement between the shareholders of the respective companies, and operation of the 90-ton Morning Star mill has been resumed. G. R. Bancroft has been placed in charge, and J. A. Mackenzie is superintending engineer.

Quebec

✦ McIntyre Porcupine has incorporated Belleterre Mines to operate its Mud Lake property, east of Lake Timiskaming. The 100-ton mill is expected to be in operation in August. The mine is partly developed to 500-ft. depth.

✦ Greene-Stabell, in the Harricana area, has recently attained an assured supply of ore by discovering in the granite rocks in the northern part of its property an ore zone similar to that of Siscoe and other mines in the district. Its 100-ton mill is being supplied entirely from the new deposits. Up to the present, its vein in the greenstone has been the exception in this district; now the mine conforms to the rule in drawing its ore from the border phase of the granite.

✦ The Opemiska Mines plant, in the Chibougamau district, was swept by a brush fire in June which is said to have destroyed some of the company's buildings. Thirteen engineers are said to have lost their personal belongings, but no one was reported injured.

New Zealand

✦ Barrytown Gold Dredging, Ltd., expects to complete the installation of its bucket dredge before the end of the year. Delays have been caused by difficulty in obtaining satisfactory tenders. The company was formed by Alluvial Tin (Australia), Ltd., in September, 1934, to place a bucket dredge, capacity 200,000 cu. yd. monthly, on an area containing 20,000,000 cu. yd., valued at 10d. per cubic yard (gold £6 per ounce), at Barrytown, New Zealand. The company proposed originally to commence dredging before the end of last year. A monthly profit of £6,750 is anticipated. A pilot treatment plant has been erected to investigate the recovery of gold from the black-sand concentrate.

Iron Country

Cuyuna Range Steps Up Production

● ARMOUR MINE unwatered — Washing plants operating six days a week

✦ Activity is increasing on the Cuyuna range and some of the mines are working seven days a week. The heaviest shipper is the Evergreen Mines Company, which takes ores from Hillcrest, Evergreen, Portsmouth, and Wearne pits. The Alstead mine is being put in condition by this company to ship this season. The Hanna Iron Ore Company has leased the Wearne open pit, but Evergreen Mines Company will do the operating. The Inland Steel Company is unwatering the Armour No. 1 underground mine and is now down over 300 ft. With a few such mines requiring winter operation this range will soon get off the W.P.A. list. The Pickands Mather Company is operating at the Sagamore mine, at Riverton, and the Mahnomen mine, at Ironton. The Manganiferous Iron Company has dewatered the Merrit mine and is working to get it operating this season.

✦ The thoughts of most operators now center on how they can get out more ore with their present equipment. The mines are turning out such a tonnage the railroads are unable to supply the ore cars desired, making it necessary for some shifts to be lost due to the car shortage. Most of the washing plants are operating six days a week and 24 hours a day, with most of the labor being staggered so the men average five days a week.

✦ At the LaRue mine of Butler Brothers the belt conveyor bringing the ore from underground to stockpile recently caught fire and burned. Sufficient replacement materials were on hand and secured to cause only a few days' delay. No one seems to know what caused the fire, but the general opinion is that the belt got out of line and friction with some side member produced a spark which ignited the mine timbers. Some of the mines have eliminated this danger of fire by using steel construction underground wherever possible. Another fire was at the Leonidas mine of the Oliver Iron Mining Company, at Eveleth, when the round house containing two locomotives burned. No serious damage occurred to the machines, but considerable repairing was necessary to get them in operation again.

✦ At the St. Paul mine of Republic Steel Corporation two new 1¼-yd. gas shovels have been received from Marion Steam Shovel Company and are now in operation. These are part of the new pit equipment being installed there. A 2-yd. electric shovel left the range when the Cleveland-Cliffs Iron Company removed one of the Model 480 Marion shovels from the Greenway mine pit and shipped it to the company's Tilden mine, at Ishpeming.

✦ The Minnesota State Supreme Court now has before it the delinquent iron mine tax case started in 1932. The mining companies allege excessive valuations by the Minnesota Tax Commission and have carried the issue to the highest court.

✦ A new plan of vacations with pay for iron-mining wage earners is being tried out this summer by both the Oliver Iron Mining Company and Republic Steel Company. Those wage earners with five years' service or more get such vacations. Though the system may work well in the steel mills, some changes in the wording may be needed at the iron mines, as conditions call for continuous service and 90 per cent of the Mesabi range wage earners work a maximum of nine months in the pits and have three months to rest or take to the woods. This narrows paid vacations down to office and shop employees.

●

Mineral Survey for Western Labrador

The Government of Newfoundland has granted permission to Weaver Minerals, Ltd., of Montreal and Toronto, for the carrying out of a survey of approximately 25,000 square miles of western Labrador in a search for minerals. Airplane transport will largely be used, and much aërial survey work carried out. Operations are to start immediately, and, to assist the work, radio stations will be established at Northwest River, at Hamilton Inlet, and in the interior.

Fiji Islands

✦ Emperor Mines, Ltd., Tavua gold field, Fiji, is now treating 2,000 tons of 11.5-dwt. ore monthly. Recovery has been increased and the costs have been reduced. Developments at depth continue to be satisfactory, the new adit, 190 ft. below the surface, proving the continuation of the orebody to be 31 ft. wide, assaying 8 dwt.

Australia

Mill Construction Started at Big Bell

● GOLD PRODUCTION climbing in Western Australia—Ore reserves for New Occidental re-estimated

✦ Work on the foundation of the mill at the Big Bell mine, Due, W. A., has commenced and orders for plant have been placed. The initial capacity will be 30,000 tons of 4-dwt. ore monthly, and the plant is expected to be in operation by March, 1937.

✦ Australian Gold Development, N. L., has acquired an option over the dredging leases of New Pyrenees Alluvials, N. L., at Avoca, Victoria. More than 20,000,000 cubic yards containing 2.5 grains of gold per cubic yard has been proved by boring. Values will be checked and if confirmed a large bucket dredge installed.

✦ Bendigo Mines, Ltd., which has three subsidiary companies engaged in mine development at Bendigo, is to install a 30-head stamp battery to treat the ore met in the Carshalton and Nell Gwynne mines. The ore is free milling and does not require cyanidation.

✦ The ore reserves of the Moonlight mine of Gold Fields Australian Development Company, Ltd., at Wiluna, W. A., are estimated at 130,000 tons valued at 27s. per ton (gold at 84s. per fine ounce) plus an indefinite tonnage of oxidized ore. The output is being steadily increased and will reach 7,500 tons in August. The ore is railed to the Wiluna mill and treated by flotation. The antimonial-gold concentrate is to be stored until June, when the blast furnace will be in operation.

✦ Briseis Consolidated, N. L., a new company engaged in equipping the old Briseis tin mine, at Derby, Tas., for hydraulic sluicing, expects to start production in August.

✦ Western Australian gold yield for the four months ended April, 1936, totals 246,219 fine ounces, compared with 145,844 and 207,557 fine ounces for the corresponding periods of 1935 and 1934 respectively. With many new mines coming into production, and the old mines treating increased tonnages, this rate of increase should be maintained.

✦ During the six months ended April 30, 1936, Norseman Gold Mines, N. L., Norseman, Western Australia, crushed 31,055 short tons, head value 9 dwt., and cyanided 18,480 short tons, for a total yield of 10,455 fine ounces, valued at £91,526. Working expenses were £49,470, leaving a working surplus of £42,056. Development during the period comprised 2,158 ft. of driving, winzing, and complementary operations, and 527 ft. of underground diamond drilling. The expenditure on new plant and development was £20,354. The company's tailings heaps comprise 90,000 tons assaying 1.4 dwt. and 31,212 tons assaying 3.8 dwt.

✦ Southern Cross Gold Development, Ltd., which is developing the old Frasers mine, at Southern Cross, Western Australia, estimates ore reserves at 110,000 tons assaying 6 dwt. above No. 3 level. Average width is 3 ft. 6 in. The Frasers lode has been proved over a strike length of 5,000 ft. and is well defined.

✦ Lake George Metal Corporation, Ltd., the London company owning the Lake George mine, at Captain's Flat, is still investigating the recovery of elemental sulphur from pyrite, which comprises 32 per cent of the ore. On the basis of treating 1,000 tons of ore daily, the output of both sulphur and pig iron would be 30,000 tons annually. Should the tests now being made prove that the Lake George pyrite can be treated satisfactorily, a plant to mill 500 to 1,000 tons of ore daily will be installed. The Lake George orebody, which strikes north and dips slightly west, occurs in schistosed arkose and outcrops for over 5,000 ft. Ore reserves to 700 ft. are 2,880,000 tons assaying 7.5 per cent lead, 12.9 per cent zinc, 0.8 per cent copper, 2.4 oz. silver per ton, and 1.3 dwt. gold per ton. A pilot flotation plant was erected several years ago and proved that three separate concentrates—lead, zinc, and iron—could be produced.

✦ The ore reserves of New Occidental Gold Mines, N. L., Cobar, N. S. W., have recently been re-estimated as proved, 261,500 tons; probable, 101,000 tons, or a total of 362,500 tons assaying 8.4 dwt. C. E. Blackett, the new general manager, has instituted improvements in methods and organization which are likely to improve the extraction and reduce costs. The main shaft is adequate for 7,500 tons of ore monthly and when development work is sufficiently ahead the mill tonnage will be increased from 5,000 to 7,500 tons monthly.

✦ Raub Australian Gold Mining Company, Ltd., Raub, F. M. S., reports a net profit of £37,768 for the year ended March 31, 1936, after writing off against revenue £48,001. The mill treated 53,358 tons assaying 10.17 dwt. and recovered 21,532 fine ounces gold and 1,155 fine ounces silver. The ore reserves were increased by 22,000 tons to 45,000 tons. As the extensive development program is continued, ore reserves will be increased substantially. J. C. Coldham is the general manager.

"JOBURG," better known as Johannesburg, in South Africa, where tall buildings and huge tailings piles reveal progress made since the discovery of gold on the Rand in 1886. An Empire Exhibition will be opened in the city in September to celebrate the discovery of gold on the Rand fifty years ago.

Aircraft Operating Co. Johannesburg.

PERSONAL ITEMS

Dr. Anton Gray has returned to London from a visit to Rhodesia and Egypt.

Edward P. Scallon, of Crosby, Minn., has been examining mining properties near Tonopah, Nev.

Frank D. Aller expects to spend some time this summer in the mining districts of northern Mexico.

William Keener, general manager of Magma Copper Company, has been elected a director in the company.

J. A. Agnew, of London, has been appointed chairman of the Western Australia Mine Owners Association.

Robert Annan has been elected president of the Institution of Mining and Metallurgy, London, for the ensuing year.

Bela Low left New York about June 1 for Alaska, where he is in charge of a geophysical survey in the Kennecott region.

Sydney H. Ball, of the firm of Rogers, Mayer & Ball, spent the last half of June on professional business in the West.

Chard. O. Sanford, mining engineer, has removed his office from Pasadena to Room 1001 Central Building, Los Angeles, Calif.

Sherwin F. Kelly left New York for Canada about mid-June after his return from making a geophysical survey in Guerrero, Mexico.

Rensselaer Toll, of Los Angeles, Calif., is at Johnsville, Calif., planning the revival of operations at the old Plumas-Eureka mine.

H. A. Sawin, sales engineer, Yuba Manufacturing Company, has been appointed secretary of the San Francisco Section of the A.I.M.E.

James S. Wroth, engineer for the International Mining Corporation, left New York early in June for an inspection trip through Colorado.

Stanley B. Weld, metallurgist and assayer, is now with Straub Manufacturing Company with offices at 507 Chestnut St., Oakland, Calif.

George W. Scott, of the Northern Electrical Company, Ltd., has been elected chairman of the Quebec Branch of the American Society of Metals.

C. C. Freeman, who resigned the position of superintendent of Zinc Corporation, Ltd., Broken Hill, Australia, a few months ago, is visiting Great Britain.

J. Ralph Scott has been appointed consulting engineer for Mat-A-Lac Gold Mines, Ltd. The property adjoins Roche Long Lac, in northern Ontario.

Maj. R. E. Franklin is on exploration work along tributaries of the Amazon River in eastern Ecuador. His address is, care of Hotel Metropolitano, Quito, Ecuador.

William A. Beaudry, one-time manager of Golconda Lead Mines, Idaho, is now in charge of operations of Alabama-California Gold Mines at Penryn, Calif.

J. O. Greenan, manager of the southern division of Marsman & Company, left the Philippines in March on a six months' vacation in the States, his first trip home in six years.

C. M. Barkley, mining engineer, has joined the staff of the West Coast branch of Eimco Corporation and can be reached at 749 Bryant St., San Francisco, Calif.

F. A. Brien, of the Marsman staff, United Paracale Mining Company, Paracale, Camarines Norte, P. I., is now with the Balatoc Mining Company, at Acupan, Baguio, P. I.

Ernest W. Ellis, metallurgical engineer, Grass Valley, Calif., has been appointed engineer in charge of operations by the Carlyle Mining Company, Twentynine Palms, Calif.

K. F. Peters, formerly manager of the Orogrande - Frisco Gold Mines property, in Idaho, is now with the Virginia Mining Corporation, operating in Plumas County, Calif.

Wallace V. Peck is superintendent for Steen Mines, at Forney, Idaho. The mine is a gold-silver-copper property. Ore is being blocked out and a small pilot mill is in operation.

Gerald G. Dobbs, general manager of Ariston Gold Mines (1929), Ltd., Prestea Gold Coast, West Africa, who has been on leave in England, is returning to the Gold Coast in July.

John Shaw, consulting mining engineer at the J. M. Consolidated mine, will assume a similar capacity with Patricia Dent Gold Mines, Ltd., in the western part of the Patricia area, Ontario.

Charles E. Blackett, formerly general manager of Boulder Perseverance, Ltd., Kalgoorlie, has assumed the position of general manager of New Occidental Gold Mines, N. L., Cobar, N. S. W.

L. S. Harner, for 29 years general manager of the Golden Cycle mill at Colorado Springs, Colo., has been appointed general manager of the Cripple Creek Milling Company mill, at Cripple Creek, Colo.

William D. Lown, a student from Spearfish, S. D., received the ninth annual award of the J. V. N. Dorr prize of $100 at the State School of Mines, Rapid City, S. D., on commencement day, May 28.

W. F. Jones, formerly mill man for Cornucopia Gold Mines, Inc., Cornucopia, Oregon, is now employed as a flotation-mill operator by the New Bonanza Mining Company, at Battle Mountain, Nev.

Willard Chevalier, vice-president of McGraw-Hill Publishing Company, received the honorary degree of Doctor of Engineering at the annual commencement exercises of the Colorado School of Mines.

E. T. Stannard was elected president; **L. S. Cates** and **J. R. Hobbins,** vice-presidents; and **R. R. Eckert,** secretary and treasurer, at the annual meeting of the United States Copper Association, held June 19.

Roy D. Leisk, former vice-president of United Verde Extension Mining Company, has succeeded **Frank Eichelberger** as vice-president in charge of operations of Sunshine Mining Company, at Wallace, Idaho.

H. St. J. Somerset, general manager of Electrolytic Zinc Company of Australasia, Ltd., is a director of Associated Pulp & Paper Mills, Ltd., the new company formed to lay down a large plant at Burnie, Tasmania.

L. K. Armstrong, long prominent in mining sections of the Northwest, and secretary of the Columbia Section of the A.I.M.E., was recently made a life member of the Northwest Mining Association, meeting in Spokane, Wash.

W. N. Ellis has been appointed superintendent of the American Lead Corporation, at Indianapolis, Ind., which is engaged in smelting secondary lead and copper residues and is a subsidiary of the American Lead Company.

Maurice Rey, professor on the technical faculty of the University of Liége, Belgium, expects to spend the summer in the United States. His address will be in care of C. R. B. Educational Foundation, 420 Lexington Ave., New York, N. Y.

Thomas M. Bains, Jr., of Mariposa, Calif., has been appointed supervising engineer by the Mining Division of the Reconstruction Finance Corporation for the district of Northern California, with offices at 400 Sansome St., San Francisco, Calif.

H. Foster Bain has returned to New York from the Far East and will be associated for the summer in professional work with **Samuel H. Dolbear** and **Lawrence B. Wright,** mining engineers and geologists, at 17 Battery Place, New York City.

Earl E. McI. Bagley, superintendent of the Balatoc mill of the Balatoc Mining Company at Baguio, Mountain Province, the Philippines, is in the United States with Mrs. Bagley and their three sons. He will return to the Philippines in October.

Herbert A. Franke, junior mining engineer, California State Division of Mines, and secretary of the San Francisco Section of A.I.M.E., is leaving for Washington, D. C., to join the staff of the United States Bureau of Mines as assistant mineral economist.

Sam S. Coldren arrived in Manila late in April to become shift boss at United Paracale. He attended the Colorado School of Mines, and worked in Mexico for about ten years. He came to the Philippines after a three-year contract in Soviet Russia.

Mark G. Bradshaw, president, Bradshaw Syndicate, Inc., has returned to his office in Tonopah, Nev., from a protracted trip to Colorado, during which he sampled the mill tailings at the Mary Murphy mine, in Chalk Canyon 35 miles from Salida.

L. C. Penhoel, mining and metallurgical engineer, Penhoel-Menardi Engineering Company, Los Angeles, Calif., is at the Good Hope mine, near Perris, Calif., investigating milling practice for the Good Hope Mining & Development Company.

Col. D. C. Jackling, president, and **W. S. Boyd,** vice-president, have returned to their headquarters in San Francisco after an inspection trip to the Chino mines of Nevada Consolidated Copper Company at Santa Rita and Hurley, N. M.

William A. Oxnam, of Calumet, Mich., has left for Goldfield, Nev., to take a position with the Eastern Exploration Company, a subsidiary of the Calumet & Hecla Consolidated Copper Company. He was formerly employed by Calumet & Hecla and Calumet & Arizona, having been assistant secretary-treasurer of the latter company.

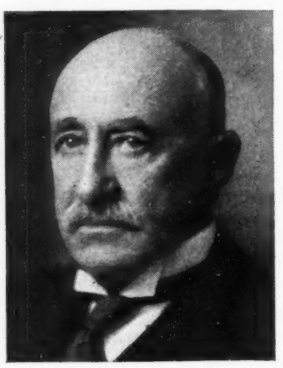
C. W. Vaupell, geologist, and **Jose A. Garcia,** mining engineer, announce the opening of offices at 411-412-413 Ave. Juarez No. 30, Mexico City, D. F. They will conduct a consulting practice covering the technical and administrative branches for mining in Mexico. **David Segura,** metallurgist, and **V. Gonzales,** mining engineer, are members of the staff.

Cornelius F. Kelley, president of Anaconda Copper Mining Company, received the honorary degree of Doctor of Laws at the 34th commencement exercises of the Montana School of Mines last month. He delivered the commencement address on "Man and Mining." Professional degrees for "distinguished service" were conferred by the Montana School of Mines on three alumni at the graduation exercises. **Peter A. Haines,** '09, general superintendent of St. Joseph Lead Company, Rivermines, Mo., received the degree of Engineer of Mines. **Arthur A. Zentner,** '11, consulting engineer, New York City, was awarded the degree of Metallurgical Engineer. **Murl H. Gidel,** '12, of the geological staff of Anaconda Copper Mining Company, was invested with the degree of Geological Engineer.

F. H. Brownell, chairman of the American Smelting & Refining Company, was reelected president of the Copper Institute at a meeting held June 19. **Cornelius F. Kelley,** president of Anaconda, was named chairman of the executive committee. **E. T. Stannard,** president of Kennecott, and **Louis S. Cates,** president of Phelps Dodge, were elected vice-presidents. **R. R. Eckert** was reelected secretary and treasurer.

OBITUARY

John Hays Hammond died at his summer home, Lookout Hill, on Freshwater Cove, near Gloucester, Mass., on June 8, at the age of 81. With the possible exception of Herbert Hoover, Mr. Hammond was the most widely known engineer of his generation. His experiences with life and opportunity were daring, dangerous, and successful. His career surpassed fictional imagination; and he lived to enjoy to the full the fruits of success and distinction. His memoirs, published in two volumes in 1935, and mentioned in an editorial appreciation which appears on page 326 of this issue, record his dramatic struggles and attainments. A review of his autobiography was published in the issue of *Engineering and Mining Journal* of June, 1935. To set forth here, even most briefly, the events that marked his progress, is impossible. Space does not permit. The record is available. It will endure. Mining engineers will ever cherish the heritage and the inspiration of Mr. Hammond's rôle in the affairs of his time and his profession.



JOHN HAYS HAMMOND

Edward Mosehauer, vice-president of Anaconda Sales Company, died on July 1 in his 58th year.

Ferdinand W. Roebling, president of the John A. Roebling's Sons Company, died on May 29, at the age of 58.

Leonard B. Miller, formerly manager for Oglebay, Norton & Company iron mines, died on June 2 at the age of 75.

W. Moore, underground engineer, was killed on June 4, apparently by the fall of the cage in No. 2 shaft of the Daggafontein mine.

Parley L. Williams, Jr., well-known Western mining man, died on June 21 at Salt Lake City, Utah, at the age of 58.

George Kaufman, for almost fifty years identified with important mining projects on the North American Continent, died recently at the age of 79.

Dr. Lucius Pitkin, founder in 1885 of Lucius Pitkin, Inc., chemists, of New York City, died on June 14 in his 79th year.

Sir Bourchier Wrey, Bart, pioneer Rand and Rhodesian mining man and former president of the Rhodesian Chamber of Mines, died recently at Tunbridge Wells, Kent, England.

Charles Whitcomb, pioneer Montana mining man, who was largely responsible for the development of the Ruby Gulch Mining Company, died recently at Zortman, Mont., in his 71st year.

Ray Benedict West, dean of the School of Engineering and Mechanical Arts of Utah State Agricultural College, died early last month at Logan, Utah, at the age of 54.

Isaac Lincoln Merill, identified with copper production in the West in the earlier days of its development, died at Daytona Beach, Fla., on June 11, aged 75.

Roger Dennis, 28, mining engineer at the Beebe mine, in Georgetown, Calif., was instantly killed when he grasped a power wire in the mine on June 14.

Percival Dewees Browning, consultant in mining engineering and former assistant professor at the Columbia School of Mines, died in New York City on June 15, aged 51.

John MacGinniss, a pioneer Montana mining man, industrialist, and capitalist, died in Santa Barbara, Calif., on May 28. He was 68 years old. He was in his earlier years associated with the Anaconda and Heinz interests.

Frank Merricks, British consulting mining engineer, and president of the Institution of Mining and Metallurgy in 1920, in which year, also, he was made a Commander of the Empire, died on June 9. He was 70 years old.

Jacobus Stephanus Cellier, a retired mining engineer prominent in the development of South Africa, and at one time professor of mining engineering at the University of the Witwatersrand, died recently at Johannesburg.

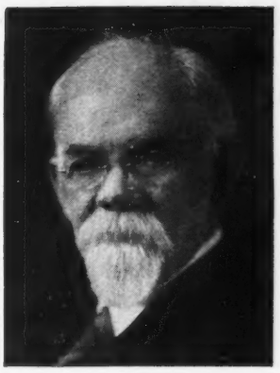
Sir Lionel Phillips, associated in the early days of the Rand with Cecil Rhodes and John Hays Hammond, and former head of Rand Mines and member of Parliament of the Union of South Africa, died in Capetown on July 1, at the age of 80.

W. A. Doman, for many years London correspondent of the *Engineering and Mining Journal,* died recently at the age of 71. As mining editor and finally editor of *The Financial News,* he was widely and most favorably known, his many friends including the several newspaper men whose abilities he helped to develop.

Fred E. Melzer, mining engineer and geologist, who had practiced his profession in Mexico, New Mexico, and Colorado, died on June 15, 1936, at the age of 39. He was an alumnus of Columbia, having graduated with the highest honors. His death followed complications that developed from pneumonia.

Conrad Schlumberger, prominent figure in the field of geophysics, died in Stockholm on May 9 of a cerebral hemorrhage. He was widely known to the mining and geological profession

for his contributions to surface geophysical exploration. Later in his career he extended his studies to the determination of formations traversed by drill holes, particularly in oil exploration, and developed methods of electrical logging that have been widely adopted. He was an extensive contributor to technical literature in this country and abroad. In the course of his career he had held the chair of physics in the School of Mines at St. Etienne and in the Ecole Superieure des Mines de Paris.



ROSS EGERTON BROWNE

Ross Egerton Browne, engineer and philosopher, died at his home in Oakland, Calif., on May 29, 1936. His career as an engineer included services in the great periods of the Comstock, the California Gold Belt, and the Rand. Browne was born in Washington, D. C., July 27, 1849, the son of J. Ross Browne, traveler, author, and diplomat. His father advised him to study mining, so he decided to attend the Royal Academy of Mines at Freiburg. He finished the course in a little over three years, being graduated in 1871. He returned to California, where he was for a short time president of the board of trustees of the State Mining Bureau of California. During the following years he undertook a considerable amount of consulting work and wrote extensively on a large variety of subjects. His last literary product was an essay, written in February of this year, on "How to Grow Old."

LETTERS

Our First Mining Graduate

The Editor:

Mining engineers who may have noted a brief item in the papers recently, saying that the mineral collection made by Adam Seybert previous to 1800 was being put on exhibition in the Museum of the Academy of Natural Sciences in Philadelphia, are not likely to have been aware of the fact that it referred to the first person born in the United States to graduate from a School of Mines. Yet such, so far as can be ascertained, is the case.

Adam Seybert was born in 1773 and graduated from the Medical School of the University of Pennsylvania in 1793. According to the scanty records of his early life, he went to Edinburgh for further study in medicine, and from there went to the Ecole des Mines to study chemistry and mineralogy. Returning, he reached Philadelphia early in July, 1796, and engaged in business as a "chemist and mineralogist," with a shop at 168 North Second St. Though one would suppose there could be but little business in that line, at that time, he somehow eventually became a rich man according to the standards of the time. From 1809 to 1815 and from 1817 to 1819 he was a member of Congress, where he prepared the "Statistical Annals of the United States," published in 1818, which was (so far as I know) the first of the statistical publications of our Federal Government, and was a very creditable job, considering the lack of facilities for gathering statistics. He prepared a catalog of American minerals and described forty. His announcements, in 1806, of the occurrence of sphalerite near Perkiomen Creek, Montgomery County, Pa., attracted much attention because of an argument which developed between Seybert and the professor of chemistry at the University of Pennsylvania as to whether it could be used for the production of zinc. Three years earlier he had named for Benjamin Silliman the few mineral specimens that then constituted the collection at Yale.

He sent his son, Henry Seybert, to the Ecole des Mines also, and when Henry returned to Philadelphia and joined his father in business he became the most skillful and competent mineral analyst in the United States. He corrected Berzelius and Kleproth in their analyses of chrysoberyl, and demonstrated the presence of magnesium in the hydraulic lime used in the Erie Canal construction work. But after Adam Seybert died, in 1825, Henry seems to have been so worried over the question as to whether a rich man could enter the Kingdom of Heaven that he appears to have done but little more scientific work, though he lived for over fifty years after his father's death. In 1883 he founded the Adam Seybert Chair of Moral and Intellectual Philosophy at the University of Pennsylvania. Both father and son deserve to be better known than they are by mining men.

THOMAS T. READ.

Columbia University,
New York, N. Y.

"The Largest in the World"

The Editor:

On page 124 of your issue of March, 1936, appears the following:

"Some five miles outside the city of Chihuahua is the largest lead smelter in the world, output of the metal considered, this now amounting to about 500 tons of bullion daily."

I would like to point out that during the calendar year 1935 the Port Pirie (South Australia) smelter of the Broken Hill Associated Smelters Pty., Ltd., produced 181,532 long tons of market lead, or the equivalent of over 203,000 short tons of 2,000 lb. This is at the rate of 557 short tons per day throughout the year. The capacity of this smelter is over 200,000 long tons, or 224,000 short tons, per annum. These figures would certainly infer that Pirie's output is in excess of that of Chihuahua, and, hence, that the latter is not the largest in the world.

Furthermore, on page 161 of the same issue appears a letter from G. H. Fairmaid referring to your issue of July, 1935, wherein there is claimed for a 3,750-hp. diesel engine installation at Balatoc, P.I., the distinction of being the "world's largest installation of diesel engines used for mining operations." I would like to direct your attention to the *Proceedings* of the Australasian Institute of Mining and Metallurgy, No. 87, September, 1932, wherein there is a paper by F. J. Mars, general superintendent of Western New South Wales Electric Power Pty., Ltd., which shows that that company (which supplies electric power and compressed air for the Broken Hill mines) has a plant comprising six 3,000-hp. Sulzer diesel engines, each coupled to a 2,500-kva. British Thomson-Houston alternator, and four 1,200-hp. Mirrlees diesel engines, each driving an air compressor of 5,500 cu. ft. per minute free air capacity—a total of over 22,000 hp. in diesel engine power, all in the one installation and used for mining operations.

A. F. EVANS.

Melbourne, Australia.

Itogon Filtration Costs

The Editor:

In explanation of the filtration costs at the Itogon Mining Company, and in answer to the letter by Donald F. Irvin in the March, 1936, *E.&M.J.*, Clarence A. Weekley, general mill superintendent of Marsman & Company, operators of Itogon, submits the following:

"During the month of February the following results were obtained on the Moore filter at Itogon. All values are figured at $20 per ounce:

	Per Ton
"Feed to Moore filter, unwashed..	$1.10
"Tails from Moore filter, washed..	0.64
"Tails from Moore filter, unwashed	0.70
"Dissolved in the Moore filter...	0.46
"Soluble loss	0.06
"Net value recovered in filters...	0.40

"If the 40c. net is calculated to the present price of gold, this saving becomes $0.68 per ton. So far as I am aware, no Oliver filter installation in the Philippines makes this much saving.

"Due to running tonnage over the capacity of the filters, the barren solution and water-wash time has been cut down, with a sacrifice in recovery. A new filter is now being installed to correct this shortage in filtering capacity.

"The operation of Oliver filters generally costs less than Moore filters. However, figuring the higher first cost and lower dissolved value gain for the Oliver it has paid us to use the Moore type filter.

"Filtering costs have averaged $0.06 for the first three months of 1936 and the soluble loss has been $0.05."

Baguio, P. I. RALPH KEELER.

NEW BOOKS

Status of Secondary Copper

SECONDARY COPPER. *By Percy E. Barbour. Secondary Copper Report of Subcommittee on Copper, Mining and Metallurgical Society of America. Published by the Society, New York. Pp. 85, with 11 charts and 15 tables. Price $1.50.*

Although this study is published as a committee report of the M.M.S.A., the author states in the preface that "the Society is in no way responsible for the findings, which are entirely my own."

The author has done a creditable piece of work in presenting available statistics on scrap and secondary copper in their relation to primary, or virgin, metal; but he has not clarified some of the misconceptions and points of controversy in what he recognizes as a very complex subject. Unless one is intimately conversant with the marketing of scrap and secondary copper, he is not likely to understand the forces, cross currents, and undercurrents that affect the market, not only for secondary metal but for primary as well. A statistical analysis may illumine this practical knowledge, but it cannot take its place. Statistically, secondary copper may average as small a part of refinery output as Mr. Barbour indicates, but its effect on the copper market may be much greater than the statistical indication. Lacking an intimate knowledge of how secondary copper really acts on the market, one may easily draw erroneous conclusions as to its behavior and influence. In the opinion of the reviewer this is the inherent weakness in the author's study.

One of the author's major conclusions, often repeated, is that secondary brass must be eliminated from secondary copper in considering the effect of the latter on mined output. "Copper and brass are two different things," he says. Apparently, he sees brass scrap always recycling to become brass ingot. The reviewer wishes to point out, however, that not only does brass scrap compete with copper—for, if there were no brass scrap to be melted into ingot, refined copper would have to be used—but under certain conditions of price and use other metals also compete with copper. Second, whether brass scrap is remelted into new refined ingot, or goes to the copper refinery, or to a brass mill or foundry, or into the export market, depends solely on market conditions, principally on the price obtained by the seller. Mr. Barbour's Table VII shows that the percentage of copper reclaimed from brass by copper refineries grew at the expense of brass ingot makers. In 1920 secondary copper reclaimed by the latter in the form of brass and alloys was about 69 per cent of secondary copper reclaimed in all forms; but it declined in 1929 to 53 per cent, and in 1934 to 42 per cent. Market and industrial conditions surrounding not only virgin and scrap copper, but also copper-base alloys and other metals and alloys, were responsible for this diversion.

Another major conclusion of the author is that the price of (refined) copper has no material effect on secondary (scrap?) production. Though it is true that over a span of years the production of scrap will depend on general industrial and trade conditions, it is equally true that special political conditions, such as wars or a utility copper-buying strike in the face of threatening legislation, may increase or decrease the available supply of scrap, and therefore of secondary copper output. Market conditions in copper—expectations of higher or lower prices in the near future—may also have an immediate effect on the amount of scrap offered to consumers. The price offered by a foreign buyer may take scrap from this market and help our mine interests. Early in May, for instance, a 2,500-ton lot of utility copper wire scrap, held for nearly two years for a higher price, was sold for export abroad, and our virgin copper producers may be considered benefited by having almost that much secondary copper removed from competition here.

Mr. Barbour conversely contends in his ultimate conclusion that "secondary copper has no effect on the market price of copper except in times of recession in industry as a whole and then only of minor importance." In laying the foundation for his conclusions Mr. Barbour first eliminates all secondary copper in brass and other alloys, as mentioned in the foregoing. Then, after dividing secondary copper into output by primary smelters and by secondary smelters, he errs, in the reviewer's opinion, by ruling out the first as primary metal because it "is not only a very small part of the total refinery output, but also it has been transformed into primary." And then he finds that primary copper is offered little competition by secondary produced by secondary smelters, since only a limited amount of this is electrolytic or fire-refined metal.

Disregarding this logic, the reviewer wishes to emphasize that all copper scrap is copper, even in brass, and that even as unrefined scrap it may compete with refined metal. Market conditions dictate. Even if secondary electrolytic only were considered, and it were as little as 7 to 7.5 per cent of refined output, except in depression years, as Mr. Barbour would have it (it was 21 per cent in 1934 and 1935), its influence in the copper market historically cannot be denied. In fact, this metal, especially that sold by custom smelters of scrap against "intake" at a price, or on settlement on the going sales price of electrolytic, has played a big part in the copper market. For fuller discussion of this phase of the subject reference is made to the reviewer's article, "Scrap and the Copper Market," *E.&M.J.*, July, 1933.

Comment cannot be extended without exceeding space available for a review, although exception could be taken to other statements and conclusions by the author. He has tackled a subject difficult and complex, especially to those who view it mainly from the statistical angle.

SAMUEL TZACH.
New York, N. Y.

The biographical memorial of Prince Gelasio Caetani prepared by Professor Robert Peele, of the Columbia School of Mines, where Caetani graduated in 1903, contains sixty pages and not ten, as stated in the June issue on page 319. It is being published by The Lancaster Press, Lancaster, Pa., at $1.25 per copy.

NEW PUBLICATIONS

Australian Investor's Handbook, Ward's. (Data on Australian mines.) Compiled to Jan. 31, 1936. Published by Ward & Co., 383 Collins St., Melbourne. Pp. 119.

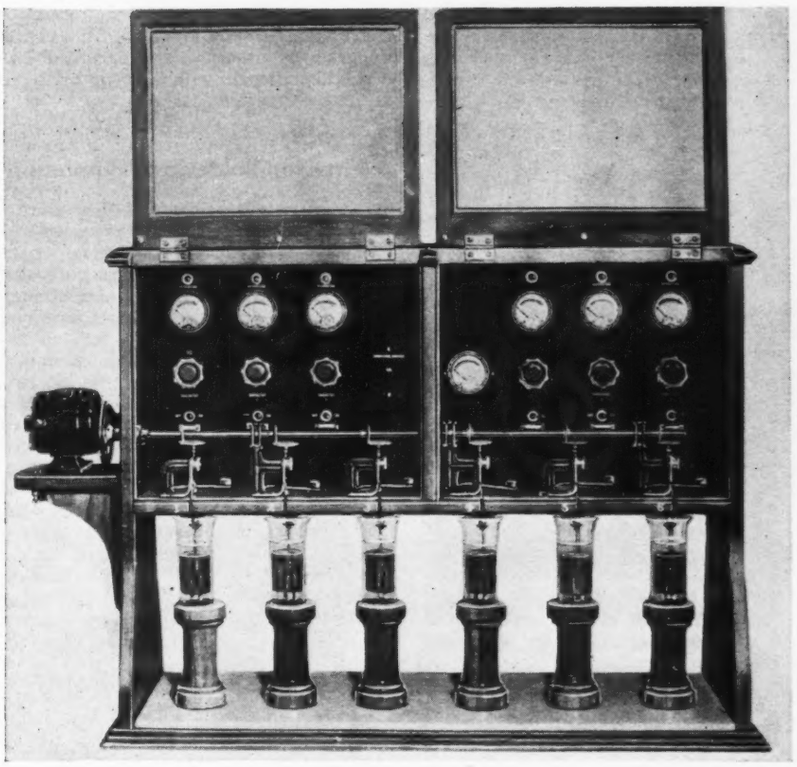
Mining Methods and Costs of the Park City Consolidated Mines Co., Park City, Utah. By Gloyd M. Wiles. Information Circular 6880. U. S. Bureau of Mines, Washington, D. C. Pp. 13.

Geology of the Chief District, Lincoln County, Nevada. By Eugene Callaghan; and **The Tuscarora Mining District, Elko County, Nevada.** By T. B. Nolan. Published as University of Nevada Bulletins at Reno, Nev. Pp. 32 and 38, respectively. Price, each, 20c.

Schwefel. By Dr. Erich Thieler. Published by Theodor Steinkopff, Dresden and Leipzig, Germany. Pp. 132, with 24 illustrations and 3 charts. The sulphur industry in Sicily, Italy, Chile, Japan, and the United States. Vol. 38 of the Technische Fortschrittsberichte. Price, 9 Reichmarks.

Available Raw Materials for a Pacific Coast Iron Industry. A report made to the U. S. War Department by Edwin T. Hodge. In four volumes. Vol. I contains, in part, a summary and the main report itself. Vol. II contains three appendices dealing with the respective subjects of Market, Scrap and Economic Factors. Vol. III includes six appendices, discussing respectively the iron ores of the Western States, the North Pacific Coast, Mexico, Central America, South America, and the Transpacific area. Vol. IV comprises four appendices covering, respectively, Fuel and Reducing Agents; Fluxes and Refractories; Manganese; and, The Cost of Pig Iron.

EQUIPMENT NEWS



Electrolytic Apparatus

Braun Corporation, of Los Angeles, has recently introduced the Model PC Electrolytic Apparatus to make determinations of substances of widely varying characteristics simultaneously. Such apparatus should be particularly desirable in custom and research laboratories, where it has heretofore been necessary to run such analyses one at a time on electrolytic outfits wired for routine work. This new model is said to save time as well as to add to convenience and efficiency, by making possible simultaneous determinations of such widely varying substances as lead, copper, zinc, cobalt, and other metals. The units of this new apparatus are said to be completely independent of each other. It is said to be possible to remove beakers from the circuits, reverse current flow, or alter it in the separate units without affecting the others. Each unit has its individual ammeter, rheostat, fuse, on-off switch, and reversing switch. Model PC Electrolytic Apparatus is an addition to the Braun line and does not displace Model CB, which is designed for heavy routine work.

Recording Voltmeter

A new strip-chart recording voltmeter which is said to be much lower in price and simpler in design has recently been announced by the Meter Department of the General Electric Company, Schenectady, N. Y. Known as the Type CD-23 and CD-24, this instrument is said to retain the refinements of the standard line of switchboard and portable recording instruments at a price reduction made possible by certain design simplifications.

The new instrument has a range of 0 to 150 volts and a single record-roll drive speed of three inches per hour. Gear units of other ratings, however, can be applied if desired. Other simplifications include replacement of the terminal block on the top of the instrument with standard binding posts on the back, mounting of a switchboard-type resistor cage in place of the back housing, and the removal of the hinged-window cover.

The new instrument is said to be compact and light, with dimensions of 6 in. x 12 in. x 11⅞ in., and weighs only 25 lb.

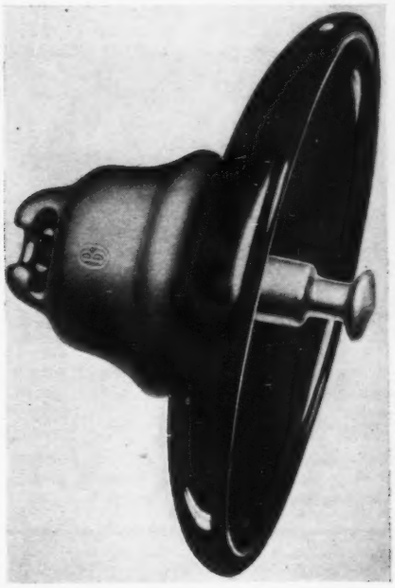
Brush Holders for Mine Motors

A number of earlier types of traction motors for mine haulage were equipped with brush holders having one insulated mounting pin. With constantly increasing loads, motors became overheated, with a consequent loosening of the mounting pin.

Through a re-design of these brush holders employing two insulated mounting pins instead of one, the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., announces that the trouble due to heating has been obviated. In addition to the new method of mounting, the latest type of twin washer-finger construction is said to be incorporated. The new mounting blocks were designed to simplify mounting of brush holders and to locate brushes properly in the correct neutral position. The new brush holders are available for type motors number 902, 904, and 909.

Rock Deflecting Insulator

The Ohio Brass Company, Mansfield, Ohio, announces that it now furnishes a sturdily constructed suspension insulator for use on line sections where shooting and rock throwing are experienced. This new



insulator is made without petticoats. The smooth lower surface tends to deflect a rock or bullet, with less damage to the insulator. In addition, the manufacturer claims the smooth under surface makes cleaning of the insulator both easier and quicker. It is claimed that the thicker section of porcelain incorporated in this new unit increases resistance to the insulator, to breakage in handling, or transporting across rugged or mountainous country.

These suspension insulators are furnished with 10-in. disks in both 5 and 5¾-in. spacing. Choice of either ball-socket or clevis attachment can be had in the 5¾-in. spaced unit. The 5-in. spaced unit is made only with ball-socket attachment.

Centrifugal Pumps

Capacities of 1,600 g.p.m., heads to 280 ft., and designed for general service pumping where small space and low weight are essential, Goulds Fig. 3620 motor-driven centrifugal pumps are said to be available

in standard and special constructions for the handling of ordinary and corrosive industrial liquids. Fifteen sizes meet all capacity requirements from 5 to 1,600 g.p.m. with heads to 280 ft. The combining of pump and motor in a single unit is said to permit reductions in over-all dimensions and weight without sacrificing strength or durability. Substantial construction throughout and the mounting of all moving parts on a single oversized shaft, running in heavy-duty ball bearings to eliminate friction and wear, are said to assure alignment and eliminate vibration, and permit operation of the pump in any position. Impellers, designed for high pumping efficiency, are the inclosed single-suction type with safe motor load characteristics, mechanically and hydraulically balanced. It is said the casings may be swivelled to any of four positions and are fully equipped with priming, drain openings, and air-vent cock.

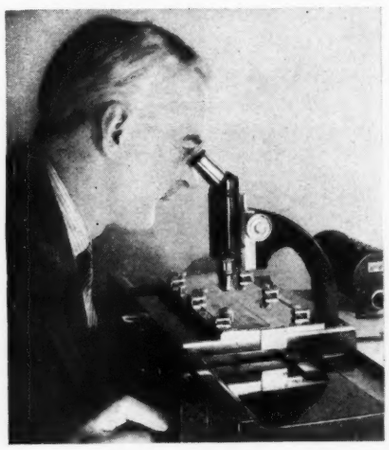
Fan-cooled Inclosed D. C. Motor

For general service in dusty atmospheres a new line of fan-cooled, totally inclosed direct-current motors is announced by

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Sizes of the new SK motor range from 5 to 75 hp. for 115, 230, and 550 volts direct current. These motors are built so that all foreign matter is excluded from the interior, which is also protected against water.

Spectrum-Measuring Microscope

A new spectrum-measuring microscope has just been designed in the laboratories of Bausch & Lomb, Rochester, N. Y., for the rapid and precise measurement of the linear intervals between spectrum lines on the photographic plate. Its precision and accuracy, however, is said to make it applicable to a wide range of work, such as the examination of shrinkage and expansion of photographic films in aërial map-



ping, measurement of thermal expansion of metals, and the elongation of test specimens in creep tests under load.

The photographic plate or other object to be measured is carried in a horizontal position upon a sliding table to which a glass is rigidly attached. The object is therefore in constant fixed relation with a measuring device which is itself constant. The scale is 250.0 mm. long, ruled directly upon a thick glass plate, and is read by transmitted light. The magnified image of scale and vernier is projected by a microscope objective upon a horizontal ground-glass screen underneath the eyepiece of the reading microscope. For the operator who is measuring spectrum lines, there is added to the observing microscope, behind the objective, a small slide carrying interchangeable spherical and cylindrical lenses.

When the cylinder is in position and adjusted so that its axis is perpendicular to the spectrum line, the images of the individual silver grains are drawn out into overlapping lines, giving the image a smooth appearance in which all evidence of grain is absent. The spherical lens, which interchanges with the cylinder, serves to keep the system parfocal.

Flux for Soldering Aluminum

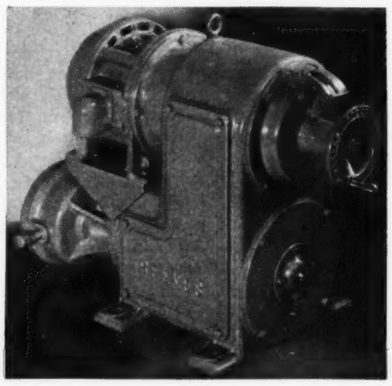
Of interest to solder and flux users is the new flux developed by the Alumaweld Company of America, 2442 South Park Way, Chicago, Ill. The new flux used in conjunction with a special, high-strength solder is said to do a job heretofore considered impossible.

Alumaweld solder and flux is applied with an ordinary soldering iron or blow torch and the soldering job is done at a low temperature, but it is said to have the advantage of requiring high temperatures to melt it a second time. It is supposed to work equally well on aluminum, stainless steel, die-cast pot metals, cast iron, copper and brass, which makes it possible to join different metals if desired.

Alumaweld solder is said to have a tensile strength of 12,000 lb., which is ten times that of ordinary solder.

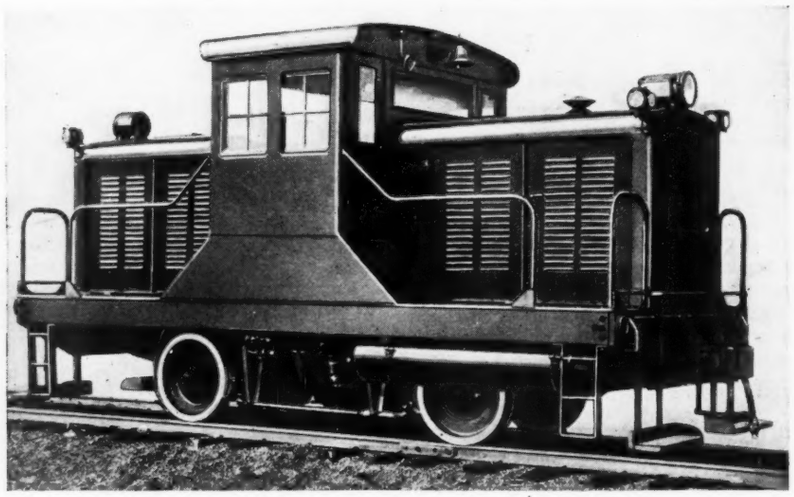
Variable-Speed Motor Drive

To meet the need for a variable-speed drive which combines in a compact, self-contained inclosure any standard make of



constant-speed motor, variable-speed control mechanism, and (where required) speed-reduction gears, Reeves Pulley Company, Columbus, Ind., has developed the Reeves Vari-Speed Motordrive.

The Motordrive is said to combine features of the Reeves Variable-Speed Transmission and Vari-Speed Motor Pulley. It is said to utilize the proved mechanical principle of a V-belt running between two sets of cone-faced disks which are adjustable in diameter and mounted on parallel shafts. One shaft receives power at constant speed from the motor and the other shaft transmits power at infinitely adjustable speeds to any driven machine. A system of ventilation to maintain uniform temperatures of motor and variable-speed mechanism, and positive and effective lubrication, with conveniently located force-feed fittings, are said to be provided. An-



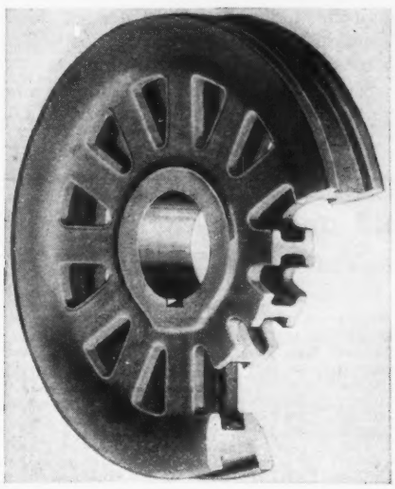
THIS 55-TON Euclid Diesel-Electrical Locomotive is built by the Euclid Road Machinery Company, of Cleveland, Ohio. Plug-in electrical connections and separate locomotive air-brake line connections are said to permit instantaneous coupling and uncoupling in changing from unit operation to multiple operation. One engineer can operate this entire multiple unit from either cab

other feature is that the variable-speed shaft may be extended on either side of the unit as required.

The drive is available in two modern and compact designs—horizontal and vertical. Each design is built in four sizes, which take motors from ¾ to 7½ hp. with speeds ranging from 1.35 r.p.m. to 3,480 r.p.m. Motor capacities cover speed ratios from 2:1 through 6:1.

Crane Wheels

To obtain full advantage of the characteristics of 13 per cent manganese steel, and to eliminate entirely the possible breakage of the web, engineers of the American Manganese Steel Company, of Chicago Heights, Ill., announce the new double-wall crane wheel illustrated. The walls are continuous with the flanges. which form of construction is said to give them a strong but elastic support and high resistance to side thrusts. The walls are integrally tied together with internal cross-spokes. Metal sections are equalized, making possible, in manganese-steel foundry practice, a perfect heat-treatment, resulting in the maximum toughness in the steel.



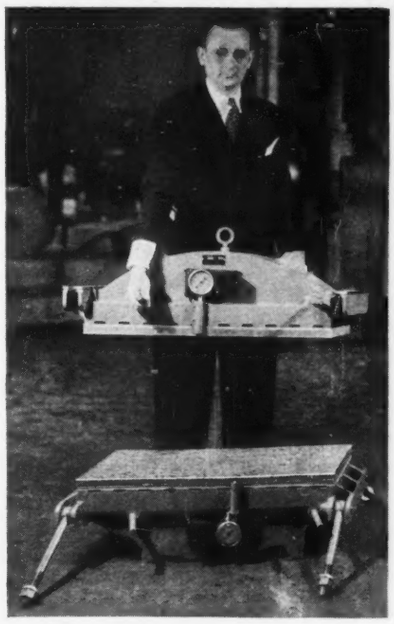
The inherent structural strength of the new double-wall design, combined with the acknowledged toughness, strength, and wear-resistance of manganese steel, is said to make these wheels highly economical in all traveling crane service, and particularly under heavy and abrasive conditions. These wheels are said to be made in all diameters, for all cranes, with hub lengths, bores, and other optional dimensions to suit the user's requirements.

Aluminum One-Man Vulcanizer

The Goodrich No. 28 Aluminum One-Man Vulcanizer, for vulcanizing splices in transmission or conveyor belting up to 28 in. wide, is a recent development of the B. F. Goodrich Company, Akron, Ohio.

Through the use of aluminum, the cost of this unit is said to have been greatly reduced and its weight lowered to under 300 lb., which is said to be 75 per cent lighter than similar vulcanizers of this size. Either of the two platens can be handled by one man or the entire vulcanizer lifted by two men.

The Goodrich No. 28 Vulcanizer is said to equal the efficiency of any vulcanizer for transmission and conveyor belts up to 28 in. and offers the added advantage of being able to vulcanize narrow transmission belts up to 10 in., 6-ply inclusive, in one heat. The unit is available in 110 or 220 volts a.c. and d.c., 110 and 220 volts a.c., and 110 or 220 volts a.c.-d.c. The



d.c. types may also be used for a.c. of equal voltage by changing the plug-in connections on the side of the vulcanizer. Vulcanizer comes equipped with curing pad and galvanized-sheet covers. No clamping bars are necessary.

INDUSTRIAL NOTES

A Half Century of Electrical Progress sponsored by the Schenectady, N. Y. Chamber of Commerce was celebrated in that city on June 12 and 13 to commemorate the establishment of the electrical industry there by Thomas Alva Edison on June 14, 1886. Starting with two abandoned shops of the McQueen Locomotive Company as a new location for the Edison Machine Works, Edison laid the foundation for a local industry which later developed into the present General Electric Company.

The Dorr Company announces a transfer of its main office to the ninth floor of the General Electric Building, 570 Lexington Ave., New York, N. Y. Hereafter the engineering department will be permanently located in New York instead of Denver. Research and development will continue to be handled at the Westport mine, Westport, Conn. The new quarters have a large reference library, which is open to clients and friends.

The Lincoln Electric Company, Cleveland, Ohio, announces the appointment of the Intermountain Belting & Packing Company as its agent, at 1414 Wazee St., Denver, Colo., covering the State of Colorado and part of Kansas, Nebraska, and Wyoming.

Hercules Powder Company's new New York office is at 22 East 40th St., at Madison Ave. Walter M. Annette is manager.

BULLETINS

Hydraulic Giants. Joshua Hendy Iron Works, 206 Sansome St., San Francisco, Calif. For hydraulic mining and earth-moving operations. Bulletin 202. Pp. 4.

Ball Mills. Overflow and rapid discharge type mills for ore grinding. Joshua Hendy Iron Works, 206 Sansome St., San Francisco, Calif. Bulletin 203. Pp. 4.

Hollow and Solid Mining Steel. Hadfields, Ltd., Sheffield, England. Hecla 18 brand. Pp. 8. Also a 1-page leaflet on Hecla 70 chisel steels.

Heavy Duty D.C. Motors. Reliance Electric & Engineering Co., Cleveland, Ohio. Bulletins 215 and 216 on various six-pole Type T motors. Pp. 4 each.

Pneumatic Sponge (Pump). Byron Jackson Co., Berkeley, Calif. Bulletin 360-C. A rotary air-motor-driven centrifugal pump for 50- to 150-ft. heads. Pp. 4.

Positive Displacement Blowers. Roots-Connersville Blower Corp., Connersville, Ind. Bulletin 22-B12. For foundry cupolas. Pp. 4.

Redler Conveyor-Elevators. Stephen-Adamson Mfg. Co., Aurora, Ill. Catalog 42. Pp. 36.

Pumps. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletins W-111-B9 and W-111-B8 on horizontal single-piston pumps for pressures up to 250 lb. per square inch; W-423-B3, on vertical triplex single-acting power pumps; W-318-B7, on balanced multi-stage volute centrifugal pumps for boiler-feed service; W-323-B3A, on Monobloc centrifugal pumping units; W-320-B2, on two-stage volute centrifugal fire pumps; W-321-B6A, on Monobloc condensate return units with centrifugal pumps; and Bulletin W-317-B5 on Freeflo centrifugal pumps for underpass drainage. Pp. 4 each.

Diesel Engines. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin S-500-B29 on vertical, four-cycle, direct-injection Type-C engines. Pp. 8.

Mine Locomotives. General Electric Co., Schenectady, N. Y. GEA-1048A, pamphlet, explaining features of heavy-duty trolley-type mine locomotive. Pp. 4.

Crushers. Jeffrey Manufacturing Co., Columbus, Ohio. Bulletin No. 622, containing tables of dimensions and capacities of double-roll crushers and disintegrators. Pp. 8.

Firebrick. Babcock & Wilcox, 85 Liberty St., New York, N. Y. Pamphlet containing table and graph of five types of firebrick. Pp. 6.

Product Catalog No. 36 of American Brake Shoe & Foundry Co., illustrating brake shoes and various types of castings, feeders, gears, shovel dippers, switches, car wheels, and welding rods. Pp. 32.

Lenses, Prisms and Mirrors. Bausch & Lomb Optical Co., Rochester, N. Y. Catalog D-10, containing tables and price lists of various optical parts. Pp. 19.

Mine-Car Roller Bearings. Timken Roller Bearing Co., Canton, Ohio. A new 8½x11 in. supplement called "Timken Engineering Journal," which is divided into six sections presenting a complete listing with diagrams and data from which bearing sizes may be selected for any loading for all types and classifications of mine cars, in capacity from 1½ tons to 35 tons. Pp. 60.

Flotation Index. Great Western Electro-Chemical Co., San Francisco, Calif. The eighth annual edition, containing lists of articles, abstracts, books, and other literature on flotation published by trade journals, technical schools, societies, and government bureaus in the principal countries of the world.

Dust Control. Pangborn Corp., Hagerstown, Md., has published a new book written by W. O. Vedder on "Industrial Dust Control Through Exhaust Systems." It describes the design, operation, and maintenance of exhaust systems in use in the industrial field. Copies will be sent gatis only to interested parties making request on company letterheads.

SUMMARY OF

MONTHLY COMMENT . . . DAILY AND AVERAGE MONTHLY

CONSUMPTION of major non-ferrous metals, as a group, held at about the same level in June as in the preceding month, but the price structure was not quite so firm. Prime Western zinc was reduced 5 points on a little selling pressure that developed soon after buyers claimed that the metal was available at concessions. Weakness in the London market for zinc had a depressing influence on the situation here, particularly in High Grade. The sharp break in tin prices stood out boldly in the month's news, and the weakness was accepted as evidence that producers are running into difficulties in renewing the control plan that expires at the end of 1936. Copper prices were slightly lower abroad, but unchanged here.

Apparent consumption of copper in the United States during the first half of 1936 was estimated at 339,500 tons, against 230,100 tons in the same period last year, an increase of 47.5 per cent. Deliveries of lead in this country in the Jan.-June period totaled about 216,500 tons, against 195,432 tons in the same time last year, an increase of 10.8 per cent. Domestic deliveries of zinc to consumers, covering all grades, totaled 252,487 tons in the half-year period, against 214,972 tons in 1935, an increase of 17.4 per cent. The record for the first six months of 1936 also shows that steel output rose approximately 33 per cent, automobile production increased 9 per cent over last year, and sales of electrical equipment and appliances gained 25 per cent.

Sales of copper in the domestic market during June totaled 16,521 tons, against 16,303 tons in May and 158,064 tons in April. Sales in the first six months totaled 338,650 tons against 163,500 tons in the same period last year. The fact that new business booked in the last month was light in volume had no influence on the views of sellers. Consumption of copper is holding at around 60,000 tons a month. The threat of labor trouble in the steel industry was a disturbing factor toward the end of June.

Domestic apparent consumption of lead during June was in excess of 38,000 tons, against 34,000 tons in May.

Sentiment in zinc was mixed last month, under the influence of lower London quotations and on prospects of a moderate decline in consumption.

The *E.&M.J.* index number of non-ferrous metal prices for June was 72.02, against 72.51 in May.

United States Market

1936 June	Electrolytic Copper Domestic (a)	Electrolytic Copper Export (b)	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
1	9.275	8.750	44.500	4.60	4.45	4.90
2	9.275	8.750	44.000	4.60	4.45	4.90
3	9.275	8.750	43.000	4.60	4.45	4.90
4	9.275	8.750	42.750	4.60	4.45	4.90
5	9.275	8.750	43.875	4.60	4.45	4.90
6	9.275	8.750	43.675	4.60	4.45	4.90
8	9.275	8.725	43.125	4.60	4.45	4.90
9	9.275	8.750	42.125	4.60	4.45	4.90
10	9.275	8.750	42.125	4.60	4.45	4.90
11	9.275	8.750	42.625	4.60	4.45	4.90
12	9.275	8.775	42.500	4.60	4.45	4.90
13	9.275	8.775	42.375	4.60	4.45	4.90
15	9.275	8.775	41.500	4.60	4.45	4.90
16	9.275	8.775	41.600	4.60	4.45	4.90
17	9.275	8.800	41.375	4.60	4.45	4.90
18	9.275	8.775	41.125	4.60	4.45	4.85 @ 4.90
19	9.275	8.800	41.500	4.60	4.45	4.85
20	9.275	8.800	41.875	4.60	4.45	4.85
22	9.275	8.800	42.000	4.60	4.45	4.85
23	9.275	8.850	42.600	4.60	4.45	4.85
24	9.275	8.875	42.750	4.60	4.45	4.85
25	9.275	8.875	41.700	4.60	4.45	4.85
26	9.275	8.850	40.500	4.60	4.45	4.85
27	9.275	8.875	40.500	4.60	4.45	4.85
29	9.275	8.850	40.600	4.60	4.45	4.85
30	9.275	8.825	41.000	4.60	4.45	4.85
Av. for month	9.275	8.790	42.204	4.60	4.45	4.880
Averages for Week						
June						
3	9.275	8.771	44.325	4.60	4.45	4.900
10	9.275	8.746	42.946	4.60	4.45	4.900
17	9.275	8.775	41.996	4.60	4.45	4.900
24	9.275	8.817	41.975	4.60	4.45	4.854
Calendar Week Averages						
June						
6	9.275	8.750	43.633	4.60	4.45	4.900
13	9.275	8.754	42.479	4.60	4.45	4.900
20	9.275	8.788	41.496	4.60	4.45	4.879
27	9.275	8.854	41.667	4.60	4.45	4.850

Silver, Gold, and Sterling Exchange New York and London

1936 June	Sterling Exchange "Checks"	Sterling Exchange "90-day demand"	Silver (c) New York	Silver London	Gold (d) United London	Gold (d) United States
1	4.99625	4.98625	44.750	Holiday	Holiday	$35.00
2	4.99750	4.98750	44.750	19.8750	139s 2 d	35.00
3	5.01750	5.00500	44.750	19.9375	138s 10 d	35.00
4	5.03375	5.02125	44.750	19.9375	138s 3½d	35.00
5	5.01250	5.00000	44.750	19.9375	138s 6½d	35.00
6	5.01125	5.00000	(e)	20.0000	138s 9 d	35.00
8	4.99750	4.98625	44.750	20.0625	139s 4 d	35.00
9	5.00125	4.98750	44.750	19.8750	139s	35.00
10	5.01375	5.00000	44.750	19.8750	138s 8½d	35.00
11	5.01500	5.00125	44.750	19.8125	138s 9 d	35.00
12	5.02500	5.01125	44.750	19.8750	138s 6½d	35 00
13	5.02625	5.01125	(e)	19.8750	138s 7½d	35.00
15	5.02750	5.01125	44.750	19.8750	138s 9 d	35.00
16	5.03625	5.02000	44.750	19.8125	138s 5 d	35.00
17	5.03250	5.01625	44.750	19.7500	138s 3 d	35.00
18	5.02750	5.01250	44.750	19.6250	138s 7 d	35.00
19	5.02750	5.01125	44.750	19.4375	138s 6 d	35.00
20	5.01500	5.00000	(e)	19.6875	138s 9 d	35.00
22	5.01250	4.99750	44.750	19.5625	138s 9 d	35.00
23	5.01500	5.00000	44.750	19.6250	138s 9 d	35.00
24	5.02250	5.00750	44.750	19.8125	138s 7½d	35.00
25	5.02000	5.00500	44.750	19.7500	138s 7 d	35.00
26	5.01750	5.00250	44.750	19.6250	138s 8 d	35.00
27	5.03000	5.01375	(e)	19.6875	138s 9½d	35.00
29	5.02375	5.00875	44.750	19.5000	138s 8½d	35.00
30	5.01750	5.00250	44.750	19.4375	138s 8 d	35.00
Av. for month	5.01817	.....	44.750	19.770	.....	35.00
Averages for Week						
June						
3	4.99875	.....	44.750	.....	.....	.....
10	5.01167	.....	44.750	.....	.....	.....
17	5.02708	.....	44.750	.....	.....	.....
24	5.02000	.....	44.750	.....	.....	.....

Calendar week averages: New York Silver, June 6th, 44.750; 13th, 44.750; 20th, 44.750; 27th, 44.750.

(e) No quotation.

The above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis, add 0.225c. per pound, the average differential for freight and interest charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.300c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order issued April 24, 1935, the U. S. Government's price on newly mined domestic silver was established at 77.57.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

THE MARKETS

PRICES OF METALS . . . MISCELLANEOUS QUOTATIONS

London Market

1936 June	Copper Standard Spot	Copper Standard 3M	Copper Electrolitic Bid	Tin Standard Spot	Tin Standard 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
				Holiday					
1									
2	36.5000	36.7500	40.5000	192.0000	189.0000	15.3750	15.5000	14.1875	14.5000
3	36.2500	36.5625	40.2500	187.0000	185.0000	15.1875	15.2500	14.1250	14.3750
4	36.0000	36.3125	40.0000	183.0000	181.3750	15.1875	15.3125	14.1875	14.3750
5	36.0000	36.3125	40.0000	187.2500	185.3750	15.1875	15.3125	14.1250	14.3750
8	36.2500	36.5625	40.1250	187.7500	185.6250	15.3125	15.4375	14.2500	14.4375
9	36.2500	36.5625	40.5000	184.5000	182.2500	15.5000	15.5000	14.1250	14.3750
10	36.0625	36.3750	40.3750	183.5000	181.5000	15.3125	15.4375	14.1250	14.3750
11	36.0625	36.3750	40.0000	184.7500	182.7500	15.1875	15.3125	14.1250	14.3750
12	36.2500	36.5000	40.2500	185.5000	183.2500	15.1875	15.3750	14.0000	14.2500
15	36.1875	36.4375	40.1250	181.0000	179.0000	15.0000	15.1875	13.7500	14.0000
16	36.1250	36.3750	40.1250	181.0000	179.7500	15.0000	15.1250	13.6875	13.9375
17	36.2500	36.5000	40.2500	180.5000	178.7500	15.0625	15.1250	13.4375	13.6875
18	36.2500	36.5625	40.1250	178.2500	177.0000	15.0625	15.1875	13.3125	13.5625
19	36.4375	36.6875	40.2500	180.0000	178.5000	15.1875	15.3125	13.6875	13.9375
22	36.5000	36.8125	40.5000	182.5000	180.2500	15.0625	15.1875	13.7500	14.0000
23	36.5625	36.8750	40.7500	184.7500	181.2500	15.1250	15.1875	13.8750	14.1250
24	36.5625	36.8750	40.7500	185.5000	182.0000	15.2500	15.3125	13.9375	14.1875
25	36.6875	37.0000	40.7500	185.7500	183.0000	15.1250	15.1875	14.0000	14.1875
26	36.6250	36.8750	40.7500	176.5000	174.2500	15.0625	15.0625	13.7500	13.9375
29	36.5000	36.7500	40.5000	176.7500	173.7500	15.0625	15.0000	13.6875	13.8750
31	36.5000	36.8125	40.6250	178.7500	175.7500	15.1250	15.1250	13.6875	13.6875
Av. for month	36.324	.....	40.357	183.167	.....	15.170	15.259	13.896	14.122

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated.
(July 1, 1936)

Miscellaneous Metals

Aluminum, ingot, 99 plus per cent, lb.	19@21c.
Antimony, domestic, spot, lb.	11.125c
Bismuth, ton lots, lb.	$1.00
Cadmium, lb.	$1.05
Chromium, 97 per cent grade, lb.	85c.
Nickel, electrolytic cathodes, lb.	35c.
Magnesium, 99.8 per cent, carloads, lb.	30c.
Palladium, troy oz.	$24.00
Platinum, (official quotation) troy oz.	$38.00
Quicksilver, flask of 76 lb., 100 flasks or more	$73.50
Radium, mg. radium content	$40.00
Selenium, 99.5 per cent, lb.	$2.00
Silicon, minimum 97 per cent, spot, lb.	16.50c.
Tellurium, lb.	$1.75@$2.00
Thallium, 100 lb. or more, lb.	$6.50
Titanium, 96 to 98 per cent, lb.	$6.00
Zirconium, commercially pure, lb.	$7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45@47 per cent, c.i.f., long ton	$16.00@$16.50
Iron Ore, Lake Superior, long ton:	
Old Range bessemer	$4.80
Mesabi bessemer	$4.65
Old Range non-bessemer	$4.65
Mesabi, non-bessemer	$4.50
Lead (Galena) 80 per cent Joplin, Mo., ton	$49.00
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52@55 per cent.	26c.
49@51 per cent.	26c.
44@47 per cent.	25c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	$15.50
Domestic Scheelite	$15.50
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$32.00

Metallic Compounds

Arsenious Oxide (arsenic) lb.	3½c.
Cobalt Oxide, 70@71 per cent, lb.	$1.41@$1.51
Copper Sulphate, 100 lb.	$4.00
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb.	$1.29
Sodium Sulphate, bulk, ton	$13.00@$15.00

Alloys

Beryllium-Copper, Master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$30.00
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb.	10c.
Ferromanganese, 78@82 per cent, gross ton	$75.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained.	95c.
Ferrosilicon, 50 per cent, gross ton	$69.50
Ferrotungsten, 75@80 per cent, lb. of W contained	$1.30@$1.40

Non-Metallic Minerals

Asbestos, f.o.b. mines ton:	
Canadian (Quebec)	
Crude No. 1	$550@.....
Crude No. 2	$200@$225
Spinning fibers	$90@$150
Paper stock	$32.50@$37.50
Shorts	$11@$14.50
Vermont	
Shingle stock	$47.50.....
Paper stock	$35@.....
Cement stock	$23@.....
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 95 per cent $BaSO_4$, less than 1 per cent iron	$5.50
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a)$5.50@ $7.00
French, 56@59 per cent	(a)$6.50@ 7.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$7.00@ $9.00
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton	$18.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$22.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in.	15@30c.
2 x 2 in.	30@50c.
3 x 3 in.	75@$1.00
3 x 4 in.	$1.00@$1.25
4 x 6 in.	$2.00@$2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a)12@12½c.
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$8.50@ $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$15.00@.....
200 mesh, cream colored	$25.00@.....

(a) Nominal.

Iron and Steel

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$20.00
Basic	$19.00
No. 2 Foundry	$19.50
Steel, base prices, Pittsburgh:	
Billets, gross ton	$30.00
Structural shapes, 100 lb.	$1.90
Bars, 100 lb.	$1 95

MONTHLY AND YEARLY AVERAGE PRICES

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1935	1936	1935	1936	1935	1936
January	54.418	47.250	24.584	20.250	489.207	496.115
February	54.602	44.750	24.818	19.796	487.278	499.908
March	59.048	44.750	27.380	19.663	477.635	496.952
April	67.788	44.892	30.986	20.245	483.596	494.139
May	74.356	44.869	33.865	20.248	488.587	496.850
June	71.940	44.750	32.346	19.770	493.245	501.817
July	68.216	.....	30.500	.....	495.558	.....
August	66.366	.....	29.476	.....	496.815	.....
September	65.375	.....	29.255	.....	492.917	.....
October	65.375	.....	29.368	.....	490.577	.....
November	65.375	.....	29.284	.....	492.277	.....
December	58.420	.....	25.563	.....	492.715	.....
Year	64.273	.....	28.952	.....	490.034	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery				London Spot			
	Electrolytic						(a)	
	Domestic		Export		Standard		Electrolytic	
	1935	1936	1935	1936	1935	1936	1935	1936
January	8.775	9.025	6.583	8.358	28.077	34.706	31.261	38.788
February	8.775	9.025	6.341	8.566	27.175	35.313	30.244	39.463
March	8.775	9.025	6.526	8.708	28.518	36.040	31.607	40.227
April	8.775	9.169	7.328	8.849	31.231	36.975	34.763	41 131
May	8.775	9.275	7.794	8.819	33.344	36.690	36.733	40.839
June	8.634	9.275	7.307	8.790	30.799	36.324	34.039	40.357
July	7.775	.....	7.350	.....	31.024	.....	34.261	.....
August	7.979	.....	7.738	.....	32.646	.....	35.976	.....
September	8.504	.....	8.146	.....	34.036	.....	37.952	.....
October	8.967	.....	8.514	.....	35.226	.....	39.609	.....
November	9.025	.....	8.414	.....	35.229	.....	39.396	.....
December	9.025	.....	8.414	.....	35.097	.....	39.313	.....
Year	8.649	.....	7.538	.....	31.867	.....	35.430	.....

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotation.

Lead

	New York		St. Louis		London			
	1935	1936	1935	1936	1935 Spot	1935 3 Mos.	1936 Spot	1936 3 Mos.
January	3.692	4.500	3.542	4.350	10.321	10.514	15.397	15.494
February	3.528	4.515	3.378	4.365	10.216	10.413	16.022	16.141
March	3.579	4.600	3.429	4.450	11.012	11.188	16.608	16.767
April	3.692	4.600	3.542	4.450	12.231	12.459	16.097	16.234
May	3.962	4.600	3.812	4.450	13.861	13.940	15.530	15.601
June	4.020	4.600	3.870	4.450	13.776	13.806	15.170	15.259
July	4.123	.....	3.973	.....	14.451	14.511	.....	.....
August	4.254	.....	4.104	.....	15.774	15.792	.....	.....
September	4.413	.....	4.263	.....	16.262	16.315	.....	.....
October	4.512	.....	4.362	.....	18.209	18.209	.....	.....
November	4.500	.....	4.350	.....	17.938	17.935	.....	.....
December	4.500	.....	4.350	.....	16.803	16.828	.....	.....
Year	4.065	.....	3.915	.....	14.238	14.326	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

Tin

	Straits New York		Standard, Spot London	
	1935	1936	1935	1936
January	50.916	47.234	231.193	209.731
February	50.063	47.962	227.381	207.081
March	46.962	48.037	215.726	213.080
April	50.154	46.963	223.513	209.313
May	51.138	46.352	227.602	202.429
June	51.108	42.204	227.586	183.167
July	52.297	.....	232.397	.....
August	50.463	.....	222.935	.....
September	49.126	.....	223.929	.....
October	51.160	.....	226.891	.....
November	51.864	.....	226.452	.....
December	49.794	.....	220.075	.....
Year	50.420	.....	225.473	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1935	1936	1935 Spot	1935 3 Mos.	1936 Spot	1936 3 Mos.
January	3.730	4.848	11.994	12.207	14.488	14.719
February	3.714	4.859	11.819	12.000	15.125	15.391
March	3.894	4.900	12.095	12.250	15.983	16.190
April	4.030	4.900	12.891	13.128	15.181	15.334
May	4.220	4.900	14.534	14.685	14.536	14.777
June	4.299	4.880	13.734	13.898	13.896	14.122
July	4.325	.....	14.065	14.185	.....	.....
August	4.535	.....	14.714	14.938	.....	.....
September	4.669	.....	15.414	15.616	.....	.....
October	4.825	.....	16.440	16.674	.....	.....
November	4.850	.....	16.193	16.372	.....	.....
December	4.850	.....	15.091	15.278	.....	.....
Year	4.328	.....	14.082	14.269	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1935	1936	1935	1936
January	55.000	105.000	20.000	20.000
February	55.000	105.000	20.000	20.000
March	58.462	105.000	20.000	20.000
April	65.000	105.000	20.000	20.000
May	65.000	105.000	20.000	20.000
June	65.000	105.000	20.000	20.000
July	65.000	.....	20.000	.....
August	70.000	.....	20.000	.....
September	75.625	.....	20.000	.....
October	85.000	.....	20.000	.....
November	85.000	.....	20.000	.....
December	101.800	.....	20.000	.....
Year	70.491	.....	20.000	.....

Aluminum in cents per pound, 99 per cent grade. Cadmium, cents per pound

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1935	1936	1935	1936	1935	1936
January	14.111	12.736	72.760	76.769	34.000	36.885
February	14.250	12.967	72.500	77.000	34.000	35.000
March	14.250	13.072	72.500	77.000	32.846	34.115
April	14.029	12.673	72.500	76.731	32.000	32.846
May	12.712	12.410	72.135	74.940	32.000	32.000
June	12.500	11.707	71.460	74.192	32.000	36.346
July	12.500	.....	70.538	.....	32.000	.....
August	12.500	.....	69.000	.....	31.333	.....
September	13.177	.....	69.208	.....	36.000	.....
October	15.322	.....	71.750	.....	37.615	.....
November	14.217	.....	74.348	.....	38.000	.....
December	13.820	.....	75.200	.....	38.000	.....
Year	13.616	.....	71.992	.....	34.150	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1935	1936	1935	1936	1935	1936
January	19.00	20.00	18.00	19.00	18.50	19.50
February	19.00	20.00	18.00	19.00	18.50	19.50
March	19.00	20.00	18.00	19.00	18.50	19.50
April	19.00	20.00	18.00	19.00	18.50	19.50
May	19.00	20.00	18.00	19.00	18.50	19.50
June	19.00	20.00	18.00	19.00	18.50	19.50
July	19.00	.....	18.00	.....	18.50	.....
August	19.00	.....	18.00	.....	18.50	.....
September	19.00	.....	18.00	.....	18.50	.....
October	19.00	.....	18.00	.....	18.50	.....
November	20.00	.....	19.00	.....	19.50	.....
December	20.00	.....	19.00	.....	19.50	.....
Year	19.167	.....	18.167	.....	18.667	.....

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces.